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AGRICULTURE JANUARY 1971

The author traces developments on a Cambridgeshire farm to illustrate some principles involved in planning

Horticultural Storage and Packing Buildings

J. P. Harrison

In 1959, M. A. Manning and Son owned and farmed 105 acres of land at Willingham, Cambridgeshire, in an area associated traditionally with flowers, fruit and vegetable production. They had 50 acres in fruit and vegetables, with the remainder in arable crops.

The buildings on the holding were very inadequate as a base for operations, being an L-shaped range constructed of brick and tiles. In these the grading and packing of crops was done under difficult conditions, the roof being low and the buildings cold in winter. In addition, working space was limited due to the storage areas that were needed.

The buildings as they looked in 1970

First improvements

In deciding to make improvements, the growers had in mind first to erect a new building in which they could in due course form refrigerated stores, mainly to hold the top fruit which was the most important part of their production. They applied for assistance under the Farm Improvement Scheme to erect a building 22 ft wide by 47 ft long, divided across the centre; it was constructed in 9 in. brickwork to a ceiling height of 16 ft, had an asbestos roof and a lean-to along one side. This building, together with

alterations in the electricity supply to give 3-phase lines, cost £1,252 gross.

This part of the work was completed in 1960, together with some improvements to the access road. By that time the Horticultural Improvement Scheme had come into operation and the firm was able to apply for approval under the Scheme to provide, within the shell of the structure, two 50-ton refrigerated stores using four inches of polystyrene on the walls and ceilings, cork in the floor and gas sealing, all at a gross cost of £3,378. The total cost of these stores, inclusive of the lean-to and incidental work, was about £45 per ton of stored produce—the work was the first in the country to be approved for grant under the Scheme (see Fig. 1).

At that time the extent of the holding eligible for grant under the Horticulture Improvement Scheme was 87 acres—65 being in top fruit, 7 in flowers, 7 in soft fruit and the remainder in vegetables. With increasing production it was clear that a much larger and more convenient packing shed was required when money became available. This would be an expensive item, and although the growers knew they would need more space in the future, they could build only what they could afford at the time. In siting the new shed between the old buildings and the new lean-to under which unloading could go on, they were able to carry on their day-to-day work without too much interruption from the builders; and by using a concrete frame structure which could subsequently be extended in two directions were able to plan for a convenient overall layout.

By May 1962, the new packing shed had been designed, approved and completed with insulated roof and walls, at a gross cost of £1,335, for a floor area measuring 45 ft × 27 feet.

More cold storage

Plans were already being made by February 1963 for the next stage, which was to build in one operation two further cold stores and a lean-to on the other side of the new packing shed to correspond with the first cold chambers. The design of these stores was somewhat different but in the growers' view the result was equally satisfactory. In addition, they were less costly than the first stores. Insulation was provided by mineral wool in wall cavities instead of by applied material on the inside of the walls. The work was finished by March 1964 at a gross cost of £3,480, and the cost of about £35 per ton stored was very low indeed, even at that date (see Fig. 2).

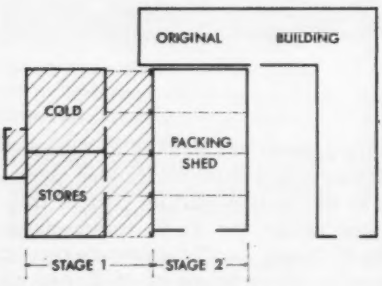


Fig. 1

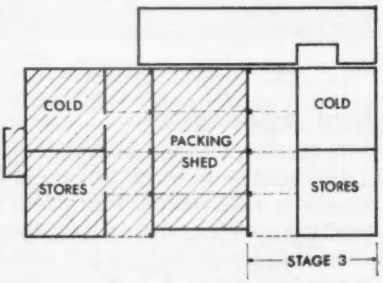


Fig. 2

Two years later, 1965, the farm had increased to 127 acres, with 100 acres of top fruit and general production rationalized by the elimination of many small vegetable crops. The need to grade and pack fruit to very high standards was demanding more space than was available, taking into account also the inevitable increases in size of machinery involved. It was, therefore, decided to extend the existing packing shed by another bay and to erect a further building at right angles to the extension to connect with it and form one large area. Concrete frameworks were again used for this new building which was 35 ft wide. Experience had shown the need for greater width and a span of 50 to 60 ft would have been preferred, but the cost would have been prohibitive. The addition, therefore, was 70 ft long by 35 ft wide and in this it was possible to install some heating. With the cost of the new concrete access required, the gross expenditure was £2,190 (see Fig. 3).

The final phase

The final phase of the work, which cost £2,663, was completed in 1969 and consisted of a further two spans of 27 ft each adjacent to the latest building. In addition, during the years of rebuilding, lavatory accommodation for the workers had been provided within the buildings and other work had been done to improve the layout. The original packing shed now serves as a workshop, except in times when extra grading room is needed, and space is available for further cold stores or other buildings in the same block (see Fig. 4).

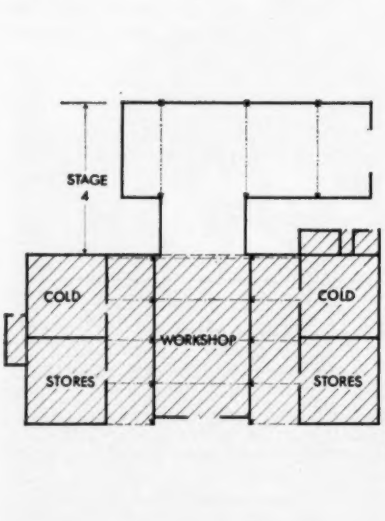


Fig. 3

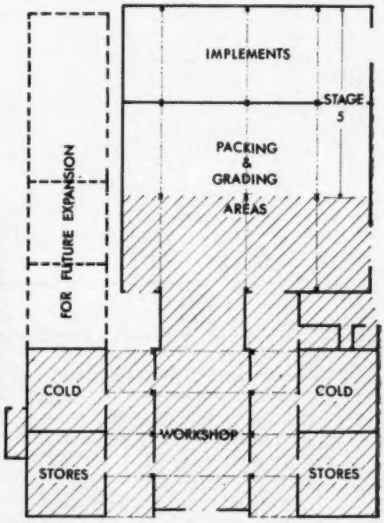


Fig. 4

In retrospect

The past ten years have seen the buildings on this holding grow from almost nothing to a very substantial unit at a total cost of something in the order of £14,000, excluding all machinery other than the equipment for refrigerating

the cold stores. Several important aspects are worth noting as being relevant to those who are contemplating building. They are:

1. There was a comprehensive plan behind this development from the start. Mr. Manning and his son, while prepared to alter details to suit changing conditions, had a very clear picture in their minds of the way in which development of the site should take place. Plans were drawn up at each stage with further developments always well in mind.
2. Financial investment was on a gradual basis, each phase being regarded as self-sufficient in that it would have to pay its way and only be undertaken when money became available. This policy sometimes meant, if returns from the year's crop were disappointing, that the next stage of development had to be delayed, but it has ensured that the business has not been burdened by interest charges which would otherwise have arisen from borrowed capital.
3. The growers took advantage of all the help available to them under grant-aided schemes for buildings, fixed equipment and machinery and also called on the help of the Ministry's Advisory Services when required.

What is illustrated very clearly by this example is the relative speed at which many horticultural enterprises develop, the greatly increased area that is required nowadays for packing and grading, and also the demands placed on employers for improved facilities for their employees. The character of the grower himself, however, probably remains the greatest single factor which influences success or failure in the long run. Undoubtedly, Mr. Tony Manning, the present managing director, has the combination of initiative and prudence which, together with a sound practical outlook, has contributed so much to the firm's success.

The author, **J. P. Harrison, A. A. Dip., A.R.I.B.A.,** is a Regional Farm Buildings Adviser of the A.L.S. at Cambridge.

Fellowships in Food and Agricultural Marketing

Two fellowships in food and agricultural marketing have been awarded by the Ministry of Agriculture, Fisheries and Food.

The first is to enable Mr. D. V. Carter, of Devizes, Wiltshire, to examine an aspect of the benefits to producers of co-operation in the marketing of agricultural and horticultural produce. The fellowship, which is for two years, is tenable at the Institute of Agricultural Economics, University of Oxford.

The second award has been made to Dr. P. D. Matthewman, of Redbrook, Near Barnsley, Yorkshire, to undertake a study of the logistics of the marketing of selected salad crops in the Yorks/Lancs region in a time of structural changes in wholesale and retail trading, the distribution of production and the transportation system. The fellowship, which is for two years, is tenable at Leeds University.

Farmers and naturalists have a common interest in a well-managed countryside. How to work more closely was discussed at a conference on

Farming and Wildlife

P. A. Naylor

MR. W. E. A. Fox farms Adbury Park Farm, Burghclere, near Newbury. He kindly agreed early in 1970 to allow the Ministry to use 300 acres of his land for an exercise involving the formulation of a farming plan and a measure of the possible effect of this plan on both farm profit and on the existing wildlife on the farm. The exercise was the centrepiece of a Conference organized in mid-September 1970 at Burghclere by the N.A.A.S. and A.L.S. as part of the Ministry's contribution to European Conservation Year. About a hundred farmers and naturalists walked the farm and had the plan and its effects presented to them for discussion.

Learning about wildlife

Adbury Park Farm is set in an area of clay and gravel soils in North Hampshire; it is rolling, well-wooded countryside, bisected by meandering streams. The exercise area contained some large open fields already under continuous cultivation, and a great deal of natural habitat, woods, copse, scrub

and hedgerows, suitable for wildlife. Attention was quickly focused on some forty acres of old water-meadows, scrub and copse. The farm plan scheduled this for clearance and reclamation, involving draining and re-routing of a stream, at a capital cost calculated at £2,500 net after grant. The aim was to bring the area into the arable rotation and the effect of this on the farm plan was clear; the extra acres made the whole operation more viable and a likely farm income of £4,500 for the 300 acres was forecast.

Wildlife

The effect of the reclamation and the resultant loss of habitat on the wildlife of the farm was not nearly so easy to forecast. The first essential was to accurately estimate what wildlife was present on the site; this involved officers of the Nature Conservancy and a number of dedicated local naturalists in the careful recording of the plant and animal species over the spring and summer months. The resultant schedules were impressive. In the area of water-meadows alone they recorded 140 plant species, including such interesting plants as tufted forget-me-not, wood club-rush, marsh valerian, marsh willowherb and bog stitchwort. Over the entire exercise area they listed sixty-seven species of birds, excluding the commonly found jackdaw, pheasant, wood-pigeon, rook, house-sparrow, starling, swallow, martin and swift. Fifty-seven of the species recorded were breeding on the farm, fifteen being summer visitors; the areas of copse and scrub were outstanding for the richness of the bird life. There were fifteen different mammals found, including the short-tailed vole, which was present in numbers in the old water-meadows, and sixteen species of butterfly.

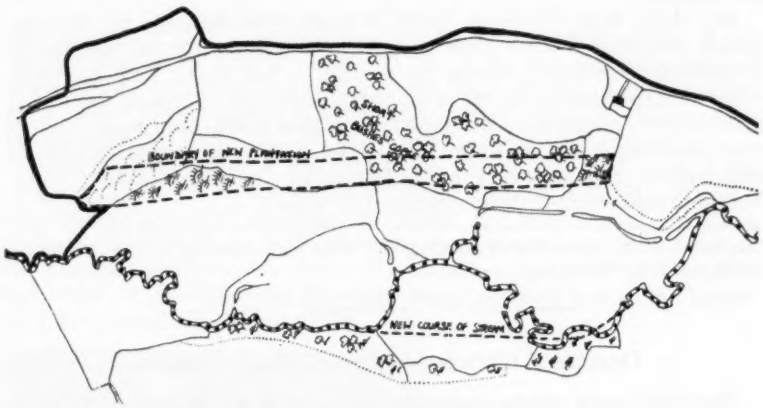
The naturalists graded the area according to its wildlife content and designated various parts of it as rich enough to be worth saving. They forecast that the farm plan, by removing habitat—especially copse and streamside marsh—would very drastically reduce wildlife. They were careful to point out, however, that there was nothing rare or vitally worth preserving. Habitat similar to that of Adbury Park was to be found elsewhere in the locality, although taking the south-east of England as a whole, marsh habitat in particular was becoming rarer. There would be some migration of species to surrounding areas.

Cost of compromise

By submitting the naturalists plan to a financial budget analysis the first estimate of the cost of saving what they thought desirable showed that Mr. Fox stood to forego some £1,200 of the farm income forecast. This was largely because it would not be worth while to reclaim the islands of meadow and scrub that would remain within the preserved habitat, leaving them suitable only for a short season of grazing by store cattle. In addition, no commensurate saving in farm overheads could be foreseen; the machinery and labour costs would probably be the same so that the slightly smaller arable area would be disproportionately less efficient. Obviously Mr. Fox, as a farmer, could not be expected to accept this loss of income and some compromise was desirable.

Fortunately the parts of the copse, scrub and two areas of marsh most interesting to the naturalist, totalling four acres, were also the most difficult to reclaim and drain. If this area were left it would form a long island of

habitat in the middle of the new arable block which would not materially affect the ease of cultivation of the land on either side and would add marginally to the game conservation value. By using budget analysis as before the cost was calculated at a much more acceptable £80 a year. The idea of game conservation was then pursued, particularly the possibility of establishing some new plantations in strategic places in addition to the habitat to be saved; these would also benefit wildlife. The cost of this more positive policy, which allowed for the establishment and maintenance of plantations and the increased value of the shoot, became £430 a year.



The river meadow and copse for reclamation at Adbury Park

Ways and means

Obviously many combinations involving either more or less habitat, natural or developed, were possible and the cost to the farm plan of any compromise could be calculated. The Conference spent some time discussing the problems of financing conservation of wildlife habitat. The naturalists had no funds readily available to offer as compensation to farmers who lost income as a result of conservation measures and pointed out their own disadvantage in comparison with farmers who could get grant-aid for the removal of habitat. They could, from local funds, and with the aid of volunteers, fence and maintain small areas of special interest if the farmer concerned was agreeable. They were prepared to purchase sites of outstanding merit but in this particular case they were plainly relying on the goodwill of Mr. Fox to conserve as much as he could. How far could one expect a farmer to financially support habitat for wildlife or game in these difficult times? No precise answer emerged from the Conference, although many farmers gave examples of their particular contributions; clearly goodwill is present to a fair degree.

One intriguing alternative possibility for the valley was that it could be developed as a sporting fishery with substantial benefit to the farm finances, even allowing for heavy development costs, so saving the bulk of the wildlife habitat. Another suggestion was that the area could become a country park grant-aided by the Countryside Commission, or that a nature trail with a charge for admission could be opened.

Common interests

As one might expect at a Conference of this kind, the discussion ranged over a wide variety of topics connected with farming and wildlife. The naturalists seemed able to demonstrate that their needs were modest and could be adapted to suit farming plans. Farmers in turn were able to quote examples of their positive attitude to conservation and the provision of habitat. Common interests became more clear and a well-managed countryside was recognized as beneficial to all. The Conference also demonstrated the wide variety of sources of information on wildlife in the countryside that are available.

Mr. Hugh Watt, of Orsett Heath in Essex, who delivered the keynote speech, described his own recent change of attitude towards the adoption of conservation measures. Among the benefits he had found were a revived interest and pleasure in the life in the countryside both by himself and by his staff, at a very reasonable cost. Good farmers have always been good countrymen; they realize that the future state of the countryside depends largely on their present management of it. The Burghclere Conference made a contribution towards helping them appraise their actions.

The author, **P. A. Naylor, N.D.A., Dip. Agric. (Leeds)**, is a County Agricultural Adviser for the N.A.A.S. in Hampshire.

Operators' Licensing—Farmers' Goods Vehicles

The 27,000 goods vehicles currently taxed by farmers under the concessionary F–licence system will be brought into the operators' licensing system from 1st March 1971 by a Commencement Order (Transport Act 1968· (Commencement No. 9) Order 1970 S.I. 1970 No. 1631 (C38)) made on 30th October, last.

To give their owners the necessary information about the operators' licensing system, the Department of the Environment has published a booklet entitled 'Farmers and Operators' Licensing', which is now available free of charge from Traffic Area Offices and County Branches of the National Farmers' Union and the National Farmers' Union of Scotland. The booklet sets out in non-technical language the requirements and obligations of the new system and how and where to apply for licences. It also includes the cost and duration of licences and gives details of those vehicles which are exempt from such licensing.

Temporary exemptions will end on 1st March 1971 and farmers should have applied for their operators licences by 28th December, 1970 or as soon after as possible.

On receiving licences farmers will be sent a copy of 'Guide to Operators' Licensing' which explains the system in detail.

The operators' licensing system does not restrict in any way the commercial use to which goods vehicles are put. But a farmer with an operator's licence wishing to continue to benefit from the concessionary F–excise licence must still comply with the restrictions on use imposed by that licence. These restrictions are that he must carry only

a. his own produce and equipment; and

b. on occasion, a limited amount of such produce or equipment for other farmers.

If he wishes to enjoy the full freedom of operators' licensing and carry goods for anyone, he will be obliged to pay the full goods vehicle rate of excise duty.

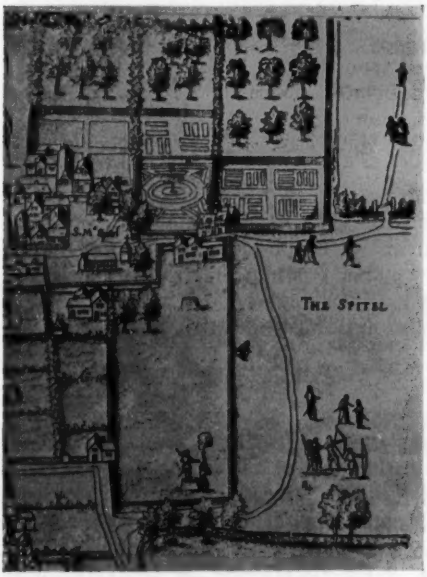
In this article the author traces the history of London's Spitalfields Market from its humble inception in the seventeenth century to the present day

Spitalfields Market

Ronald Webber

SPITALFIELDS Market is situated just beyond the eastern boundary of the 'Square Mile' of the City of London in one of the most densely populated areas of the Metropolis. Consisting of the Main Market, Annex Market, Eden House, Flower Market and the London Fruit Exchange it is one of the busiest combined fruit, vegetable and flower markets in the country.

Including administrative staff, salesmen, porters and clerks over 1,500 people are employed in this market which handles over 100,000 packages a day through some 150 wholesale merchants. The total area of the site is twelve acres, of which the Main Market covers five acres and has 226 stands for fruit and vegetables. The Flower Market has a sales area of 20,000 square feet while the London Fruit Exchange boasts of being one of the largest fruit auction buildings in the world.



Sixteenth century Spitalfields before the first market

Origin

In October 1970 the tenants of Spitalfields held an Open Day to celebrate fifty years of trading under the aegis of the Corporation of the City of London. The history of Spitalfields as a market goes back much farther than this—for it was in 1682 that one John Balch, a silk thrower, was granted a

Royal Charter which authorized him 'to keep two markets a week . . . in or near a certain place called Spittle Square'.

Spital means hospital and there was a hospital attached to the Priory of St. Mary Spital which was founded by Walter Brunus, citizen of London, and his wife Roisia during the twelfth century. The Priory was just outside the Bishop's Gate, one of the ancient entrances into the City. The Priory and hospital were pulled down at the Dissolution and the area became known as Spitalfields. In the sixteenth century it became the home of many thousands of Huguenot refugees who set up a thriving silk weaving industry. One of the old squares, now gone, was named Teasel Close because it was planted with teasels for the use of the weavers.

Types of produce

In its early days the market was a general one selling silk, meat, poultry and general merchandise rather than horticultural produce. Even by 1708 it was still described as 'a fine Market for Flesh, Fowl and Roots' while in 1725 Defoe included it in his list of 'flesh markets'.

In 1690 the first market building went up: this comprised a market house in the shape of a cross in the centre of the square, and in the four corners of the square, facing the central building, were L-shaped blocks of buildings. The central market house was one storey high with an attic.

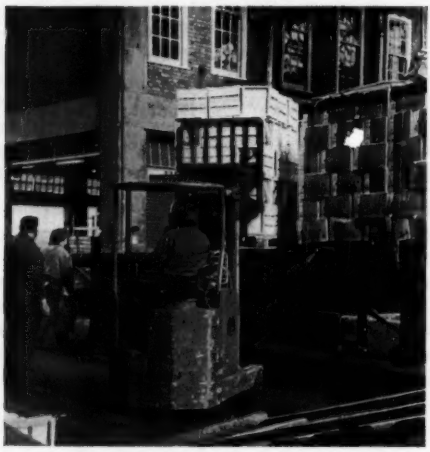
When, however, the Stocks Market, the main vegetable market of London (situated where the Mansion House now stands) was closed many of the traders moved to Spitalfields to sell their produce. And about the same period market gardening began to be established in nearby areas such as East and West Ham to be followed soon afterwards by places further east such as Barking, Plaistow and Ilford. Potatoes were a main crop but cabbages, onions, turnips, asparagus, apples, plums, currants and walnuts were also cultivated for market. More and more Spitalfields became a market place for horticultural produce.

Sometimes during the eighteenth century the market house was burnt down; it was never rebuilt. In its place rose a conglomeration of ramshackle sheds and open stalls. The construction of Union Street in 1780 gave better access but it was still not good. The market continued in this way during the first half of the nineteenth century until the coming of the railways brought produce from further afield and the increasing population of East London brought more business.

Change of ownership

In 1876, Robert Horner, who had started as a market porter and prospered, bought the remaining lease of the market. One of his first jobs was to have a new market building erected (which is now the eastern half of the present Main Market) at a cost of £80,000, completing it in 1893. He obtained the money to pay for this by charging tolls on anyone operating as a horticultural trader anywhere in the area of the market—not, as previously, just within the confines of the old market square. Horner had discovered that the original charter gave him the right to do this and in spite of several lawsuits he carried on doing so until in the end everyone was paying tolls—even the railway companies! When he eventually sold out to the Corporation of the City of London in 1920 (for £284,000) he was on his way to becoming a millionaire.

Between 1921 and 1927 the Corporation acquired property on the west side of Lamb Street, the south side of Brushfield Street and also in the former area of the Old Artillery Ground at a cost of about £250,000. By virtue of the City of London (Various Powers) Act of 1922 the Corporation acquired the right officially to hold a market on six days of the week (something that had been done unofficially for many years). In 1923 several streets were demolished to improve the main approaches. In 1929 the London Fruit Auction building was built and six years later the Flower Market was erected.



Mechanized handling of produce

Redevelopment?

The future of Spitalfields is a matter of much discussion at the present time when Covent Garden is preparing to move to a new home. Should Spitalfields rebuild on the present site or move? The Runciman Committee, in their Report on Horticultural Marketing in 1957, suggested that there should be no further expansion at Spitalfields if this were to lead to increased traffic congestion.

But since then the Corporation of the City of London has acquired a considerable area of land adjoining the western buildings of the market and has laid it out as a vehicle park and loading area. A new Annex Market has been built, and a warehouse, Eden House, has been modernized and adapted for market use.

The Corporation is now considering the re-development of the whole market with the object of eliminating street loading and improving movement within the market. A new Trading Hall will be provided with wide access roads and buyer walks. Large covered loading areas will adjoin the stands. The proposals also include a multi-storey car park for market users only as well as a public car park. Although the Greater London Council in the Greater London Development Plan have expressed doubts about the market remaining in Central London the Corporation are clearly concerned to see that Spitalfields shall be allowed to continue in the place where it has carried on its business for most of the last 300 years.

This article has been contributed by **Ronald Webber,** who is a well-known author and journalist.

Farmer's Lung

Exposure to the dust of certain mouldy vegetable produce, particularly mouldy hay and corn, can cause the respiratory condition known as Farmer's Lung, the symptoms of which include shortness of breath, fever, shivering, and a dry cough. The recent death from this disease of a farmer in Derbyshire emphasizes the need for farmers, farm workers and others who may be exposed to this dust to take special care when handling mouldy produce.

When hay and corn is harvested in a damp condition and stored, either in bales or loose, the growth of micro-organisms may cause heating. The moulds responsible for Farmer's Lung are among those which grow well in the over-heated produce and their spores may, therefore, be expected to be present in mouldy hay or corn which has been over-heated. When this produce is disturbed the dust containing the spores may be inhaled and, in susceptible individuals, may then cause Farmer's Lung. The first attack of the disease may sensitize the patient so that any subsequent exposure to quite low concentrations of the mould spores will produce further attacks.

Every effort should be taken to avoid exposure to clouds of dust containing the spores. Although there is no simple way of recognizing the crop that may be particularly dangerous, bales which produce a cloud of dust on opening or which contain white and brown streaks should be handled with particular caution. Anyone handling hay, corn, or similar produce that has been harvested in a damp condition and stored in a way that could result in heating and drying out, should take care to avoid breathing in the spores by:—

(a) keeping to windward when forking or otherwise handling sheaves of corn during threshing;

(b) providing adequate ventilation when handling produce indoors;

(c) taking care not to handle in such a way as to cause an upsurge of dust; and

(d) taking care not to inhale the dust which settles on their clothing.

A mask of plain gauze or a handkerchief round the mouth and nose do not provide adequate protection against the dust; nor can any respirator be guaranteed to give complete protection. But the divisional offices of the Ministry, can give particulars of respirators which, if used in conjunction with measures to avoid making unnecessary clouds of dust, should offer a useful measure of protection. It is important that the face piece of the dust filter respirator should fit snugly to the face of the individual wearing it, and a respirator with an inflatable edge is likely to provide the best fitting and be the most comfortable.

Anyone who has been in contact with mouldy hay, corn, straw, or other produce, should be especially careful and should consult his doctor as early as possible about symptoms such as those described in the first paragraph of this article. The doctor might also be able to help and advise about the fitting of a respirator. It should be remembered, however, that farmers, like other people, also get respiratory illnesses of common sorts and careful investigation may be needed to decide whether respiratory disease in a farmer is one of these common sorts or is associated with a specific dust hazard.

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Getting Down to Drainage

More drainage work is being done in this country than at any time since the war. To help farmers with their drainage problems the Ministry is to publish a series of ten free leaflets entitled *Getting Down to Drainage*. The leaflets will not give do-it-yourself advice but are intended to help farmers become more aware of the benefits of good drainage. They will explain the different techniques and materials available, the services that farmers can expect from contractors, drainage consultants and the Ministry, and what is involved after a scheme has been installed.

Four leaflets were published in December:

Arranging Your Drainage Contract (Leaflet No. 4)

Many farmers have not had drainage work carried out for them previously and this leaflet is designed to advise on what is involved, so that an applicant may approach a contractor with some background knowledge of the options available and the points to watch before a contract is signed. Different materials and techniques, timing of works etc are all brought to the farmer's attention.

Drainage Operations (Leaflet No. 6)

This leaflet contains advice and guidance on the main points to look for when drainage operations are being carried out on the farm. Clear, simple illustrations give a guide to these, both for underdrainage and for ditching. Attention is also drawn to the requirements for effective moling and subsoiling.

Drainage Maintenance (Leaflet No. 7)

The effectiveness of any drainage work depends upon adequate maintenance. Regular attention to a proper plan generally means that minor works will be sufficient. This leaflet illustrates the main points to which attention must be paid.

Subsoiling (Leaflet No. 10)

Using illustrations this leaflet emphasizes how water must be able to move through the soil to reach the drains if they are to be fully effective. It emphasizes the importance of good soil structure and shows how subsoiling may be necessary and how and when it should be carried out.

The remaining six leaflets to complete the series will be published later in the year. Single copies of the leaflets may be obtained free from the Ministry of Agriculture, Fisheries and Food (Publications), Tolcarne Drive, Pinner, Middlesex HA5 2DT, or from any Divisional Office of the Ministry.

Foodpack International 71

The seventh Foodpack International Exhibition will be held at Alexandra Palace, London from 2nd—5th March 1971. The exhibition will feature the latest technological developments in manufacturing, packaging, handling and distribution covering all aspects of the food industry.

Further details about the exhibition and its associated conferences may be obtained from BPS Exhibitions Ltd., 6 London Street, London, W.2.

Drainage systems are expensive to install and the economic value of any project needs to be seriously considered. This article describes the work at Drayton Experimental Husbandry Farm on

Economics of Drainage

J. E. Whybrew

THE need for drainage on heavy arable soils has always been recognized and a form of mole drainage can be traced going back to 1724. However, there is not much information available on the economic aspects of drainage.

In spite of grant aid, the cost of a drainage scheme is very high and to enable it to compare favourably with other capital demands the cost has to be recovered in a relatively short term of years. For example, suppose that an intensive tile draining system has been installed at a cost of about £70 per acre; the system itself may function satisfactorily for a period of forty or fifty years, so long as it is maintained properly, but if it is to be regarded as a feasible proposition the financial return from the system should be capable of recovering the capital outlay and also interest on the capital in a much shorter length of time. If the cost of the project is to be written off over a period of ten years it has to be capable of increasing income or reducing costs by about £11 per acre per annum. This may appear to be an impossible task but it must be borne in mind that in many cases grant aid would considerably reduce the initial outlay. Another factor that must not be overlooked is the possibility of achieving the same result, i.e., the removal of unwanted water, at much lower cost than that suggested above.

Drayton's drainage needs

The absence of information on the economic aspects of drainage suggests that there are difficulties attached to data collection. It was therefore felt that while surveys might reveal some limited information more would be achieved by carefully monitored experiments providing greater detail on all aspects of economics, hydrology and husbandry. Such experiments, although related to specific sites and all the limitations which this implies, could possibly be expanded to provide useful generalizations for future planning.

Three wet years in succession showed the need to consider the drainage at Drayton E.H.F. It was decided, in addition to carrying out necessary drainage works on a field scale, that an attempt should be made to examine various systems alongside each other in order to obtain information on their efficiency in removing unwanted water, and to assess their effect on crop yields and soil structure. At the same time the economic value of providing drainage at all would be considered. It was also hoped that it might be possible eventually to reveal the effect of drainage on soil workability.

Consultations were held between the farm staff and the Ministry's soil scientists and Field Drainage Experimental Unit, and it was agreed to develop a joint experimental site on a suitable field at Drayton. The F.D.E.U. staff were to be responsible for supervising the drainage operations, and for providing, calibrating and maintaining the recording equipment. They would also be responsible for the processing and interpretation of the hydrologic data collected from the site. The soil scientists agreed to monitor the soil conditions on the site throughout the experiment and the farm staff were to be responsible for all the farming operations on the site.

Drainage works on the experimental site in the autumn of 1969

Site

The site selected was on the Evesham series of the Lower Lias and is described in the soil survey of the area as 'Evesham. On Lower Lias Clay with little drift. Drainage slow. Mottling and Manganese concretions indicate impeded drainage from 3″ down. The texture is clay (about 60% clay fraction) and all layers are calcareous, the surface layers containing less than the lower layers. Occasional Bunter pebbles and fragments of limestone are found'.

Preliminary investigations

Long term experiments of this nature take some time to set up. Financial arrangements have to be made, specialist equipment ordered, and plans drawn up, considered, modified and reconsidered. Therefore some twelve months elapsed before any drains were actually laid. However, the time was not wasted as it enabled some preliminary investigations to be carried out on the site.

There were no records of drainage having been previously undertaken on the site. Although a few outfalls were found, they were not functioning and it was not possible to trace them for any distance. It was concluded from

their general direction that they had been placed to take water from specific wet areas rather than forming a systematic attempt to drain the whole field.

During the winter of 1968/69 small dip wells of varying depth were placed at different points in the field and water levels were recorded twice weekly. In addition soil permeability was measured in situ and this was found to be very low indeed. Instead of being measured in metres per day as is the normal case a typical result was 1 to 2 cm per day. The data collected from the dip wells showed that the soil was waterlogged for long periods during the winter. Figure 1, prepared by the F.D.E.U., illustrates the results of the dip well examinations. The low figures obtained are not surprising since water movement in a clay soil of this type depends largely on the developed soil structure; the soil profile of the field at the time was almost completely massive, probably due in part to deterioration of natural drainage over a period of time, and made worse by the very wet summer and autumn of 1968. Under such conditions, swelling of the clay would close up any structural cracks and lead to conditions of low permeability. The result of these preliminary observations suggested that the site was likely to benefit from drainage.

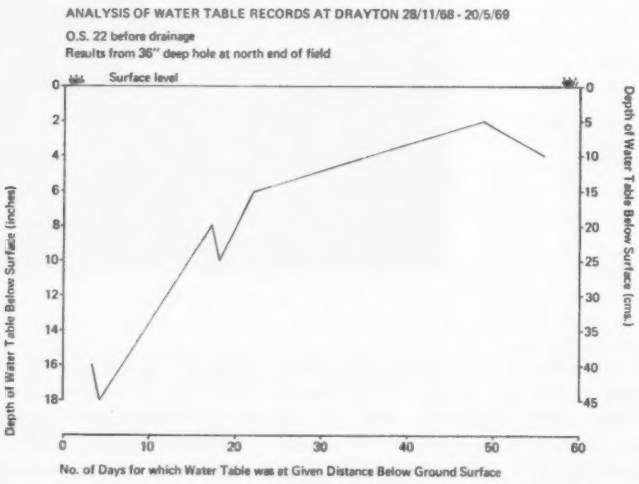


Fig. 1. Results of F.D.E.U. dip well examinations

Three comparative systems

It was decided to compare three tile systems, all at a depth of 3 ft: the first close spaced at 48 ft centres with no porous backfill; the second wide spaced 96 ft apart with porous backfill; and the third very wide spaced at approximately 290 ft apart, once again with porous backfill. Two further treatments, moling and subsoiling, were superimposed on the main treatments. There are now plots at each spacing which have been moled or subsoiled, as well as others which have been tile drained only. There is one exception, however, this being that there is no very wide spaced plot without mole draining or subsoiling; this is a logical exclusion, since very

wide spaced tile drains are used only in conjunction with mole draining or subsoiling in clay soils of this nature. The experimental site has been completed by the inclusion of two areas which are not drained, arranged so that their natural drainage is not impeded by other plots.

Each experimental plot is of about one acre in extent and is isolated from its neighbours by a polythene membrane which extends from plough depth down to four feet. This was to try to avoid the complication of subsurface water movements from plot to plot. Each drained plot is connected by sealed pitch fibre pipes to flowmeters, designed by the F.D.E.U., and sited at the edge of the field. It is therefore possible to measure all the water collected by each drainage system. Standard and recording rain gauges sited in the field provide information on the amount of rain falling and also the time that it falls so that it should be possible to calculate the relative efficiencies of each system for dealing with rainfall throughout the year.

Duplication of the undrained plot, and also the close spaced plot without moling or subsoiling, will enable some measure to be made of field variability. The site will be cropped along the lines of the normal intensive arable rotation of the farm; winter wheat, winter wheat, winter beans, winter wheat, winter wheat, winter oats, winter wheat, spring barley, one year ley. Yields will be taken each year.

The drainage operations were started in the autumn of 1969 but were not completed in time for the sowing of the winter wheat, so the crop for 1970 was barley. The crop was late sown because of poor spring weather conditions, and yields were low at about 15 cwt per acre, and variable, mainly because of seedbed conditions. An examination of yield data is therefore not of much use until the various systems have had time to settle down.

Estimated costs

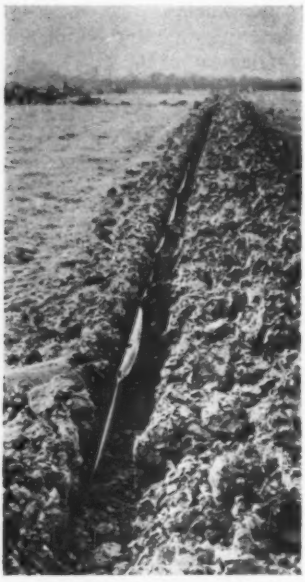
Placing realistic costs on an experiment such as this is difficult, since the draining of the plot involves expenses which are not met in the normal course of field drainage. The installation of varying lengths of sealed pitch fibre pipe and of providing individual headwalls for each outlet, to mention but two, would greatly inflate the costs if they were included. What can be done, however, is to put a price on the actual length of trench, the number of pipes, and the amount of porous backfill needed to drain an acre of land according to whichever spacing treatment is involved. Similarly, a figure for mole draining or subsoiling can be calculated.

Based on the following costs—trenching to 3 ft at £3·0 per chain, 3 in. tiles at £1·65 per chain, porous backfill at £4·37 per chain and mole draining or subsoiling at £5·0 per acre, the estimated costs of draining one acre of land under the three different systems is:

	Close spaced No porous backfill	Wide spaced With porous backfill	Very wide spaced with porous backfill
Without moling or subsoiling	£61·45	£59·35	£21·6
With moling or subsoiling	£66·45	£64·3	£26·6

These costs do not take into account any grant aid which may be available and are intended only as a means of illustration. It is interesting to note that the relative cost of the first two systems is very similar. This is due to the high

cost of porous backfill, approximately 45 per cent of the cost of drainage when it is used.



Trench showing polythene membrane separating experimental plots

Progress of the experiment

A long term experiment such as this takes some time to get under way and the last summer has been used to overcome teething troubles in recording instruments and calibrating flowmeters. The site was sown to winter wheat last autumn and it is perhaps ironically fitting that Drayton should be examining the economic value of draining in a county which numbers among its farming worthies Joseph Elkington, of Princethorpe in the county of Warwick, the great pioneer of field drainage in the eighteenth century.

This article has been contributed by **J. E. Whybrew, M.A.,** who is the Deputy Director at Drayton Experimental Husbandry Farm.

Hill Sheep Subsidy

Farmers in England and Wales who may be eligible for hill sheep subsidy for flocks kept during 1970 are reminded that completed claim forms should be returned to divisional offices of the Ministry of Agriculture, Fisheries and Food by not later than 31st January 1971.

The growing crop

Surveys by the University College of North Wales produce interesting conclusions about trends during the period 1965–68 in the

Marketing and Use of Field Beans

P. D. Hebblethwaite **G. M. Davies**

THIS article is based on data derived from two surveys carried out by the University College of North Wales at Bangor and also on data supplied by the Ministry of Agriculture, Fisheries and Food. The first survey covered forty-five marketing companies handling approximately 79,000 tons during 1966/67 and 127,000 tons in 1967/68; the second involved 156 farmers growing 2,710 acres in 1965, rising to 8,218 acres by 1968.

Prices

The data in Table 1 indicates that the prices realized for field beans were increasing. This was thought to be due mainly to an expanding export trade which is considered later. It will be seen, also, that in every year the prices growers received for spring beans were slightly higher than for winter types mainly because of their higher protein content.

Table 1 **Average price paid and received for the crop 1965–68**

£ per ton

	Price received by grower		Price paid by merchants
	Spring crop	Winter crop	(average spring and winter)
1965	28·7	26·9	
1966	27·8	27·1	28·5 (a)
1967	29·2	28·4	29·7 (b)
1968	30·3	28·8	

(a) 1966–67 (b) 1967–68

The prices paid by merchants were slightly higher than those received by growers because not all companies purchased all their crop directly from growers. Some purchased from other companies with the difference in price accounting for transport charges, merchants profit, etc.

Spot and contract purchase

Table 2 shows the percentage of total acreage and tonnage purchased by either spot or contract buying and the average price paid. Both surveys indicated a significant movement towards purchase by contract. Security and fairly attractive contracts offered by several companies are the main reasons for this trend, and it is of interest to note that, with the exception of 1967, the contract price was higher than for spot purchase.

Table 2 **Purchases by spot and contract buying 1965–68**

Year	Growers survey: Percentage of total acreage			Growers survey: Price £/ton		Marketing survey: Percentage of total tonnage	
	Spot purchased	Contract	Both	Spot purchased	Contract	Spot purchased	Contract
1965	97	3	0	25·8	27·5		
1966 or 1966/67	91	9	0	24·8	26·8	42 (a)	57 (a)
1967 or 1967/68	63	26	11	27·0	26·2	34 (b)	65 (b)
1968	20	57	23	26·0	26·5		

(a) 1966–67 (b) 1967–68

Disposal and use

All data collected shows that there are five major outlets for the crop: feed manufacture, export, seed, on-farm stock feeding and feed for pigeons.

Table 3 **Estimated disposal of the field bean crop, 1966/67 to 1968/69**

Method of disposal	1966/67		1967/68		1968/69	
	Tons 000's	Per cent	Tons 000's	Per cent	Tons 000's	Per cent
Feed manufacturers	n.c.	—	23	13·5	17	7·7
Export trade	71	60·0	77	45·0	129	58·4
Seed	14	12·0	21	12·3	21	9·5
Used on the farm or sold direct for feed*	n.c.	—	50	29·2	54	24·4
Total annual production	118	—	171	100·0	221	100·0

* Includes estimated consumption by tame pigeons.
n.c. Not collected.

(Source: M.A.F.F., 1970)

Feed manufacturing. The table indicates that only a small proportion of the crop is being used by feed manufacturers. Some larger port compounders often found that they could obtain a greater profit from the export market than by using it in rations. Compounders maintained that field beans did not compete on a least cost basis with other forms of imported protein unless they sold at or below £26 per ton. This is surprising because on analysis for cattle rations 1 cwt of beans is equivalent to 0·5 cwt of barley and 0·5 cwt of soya bean, which values the crop at over £36* per ton, approximately £6–7 per ton above the market value of the crop. However, this estimate takes no account of the biological value of the protein and the mineral and vitamin content of beans. Moreover, field beans are more difficult to process as they make a pasty meal which can block equipment, especially if the crop has more than 15 per cent moisture content. The survey showed that one of the

*Barley assumed to be 22*s.* per cwt and soya bean 51*s.* 6*d.* per cwt.

quality criticisms made by compounders was that a large percentage of the crop was not dry enough, and that wet beans can turn rancid if stored for too long.

Possibly the most important factor which prejudices the use of the crop by large home feed manufacturers is that it constitutes only about 1·2 per cent of the total possible supply of feedstuffs and 2·4 per cent of the possible protein supply of this country and also that it is not always available in sufficient quantity. Compounders are not prepared to change an already complex system in order to handle such small quantities of field beans. Again not only is supply small but it lacks continuity; for example, in 1968 production fell far short of expectation simply because of low yields.

A National Economic Development Council report* stated that there were no technical reasons against the use of field beans by the compounding industry. The report estimated that 300,000 tons could be available by 1972/73 for home compounders if expansion took place. However, the total output of 540,000 tons envisaged by the Committee as necessary to allow the above tonnage to be available for compounders would still constitute only about 3·0 per cent of the total feedstuffs available and about 5·2 per cent of the available protein in this country. The N.E.D.C. forecasts are not being achieved and in fact production is falling.

Export. Ministry of Agriculture estimates indicate that during the period 1966–67 to 1968–69 the percentage of the crop exported varied between 45 and 60 per cent. Although thirty-eight of the forty-five companies surveyed stated that part of their field bean purchase was destined for export only a few of them actually exported the crop direct themselves, the majority being sold to export companies. It is clear that the export market has expanded and developed into an important outlet for the crop. The N.E.D.C. report states that the export trade, which began in 1965, was worth about £2·5 million in 1967/68.

The main reason given for this expansion in exports was the high cereal prices in European Economic Community countries. Field beans compete not only as a protein but also as an energy crop. Dried leguminous crops imported into the E.E.C. face only a 7·2 per cent *ad valorem* tariff, which raises the export purchase price from £30 to £32 per ton. About £8 per ton is left to pay for merchant profits and transport before the crop is equal in price to cereals at £40 per ton. This takes no account of the protein bonus of beans, consequently the crop compares very favourably with cereals in the E.E.C.

The survey showed that Germany and Holland were the main importing countries, but the crop was also exported to Belgium, Italy, Spain, France, Malta and Egypt. Most of it was taken by the compounding industries of these countries, although some was used for the table pigeon industry—mainly in France—and for including in sausages in Germany.

If E.E.C. cereal prices remain at their present level there seems to be no reason why the export market should not continue to expand if supplies are available. The present price should also be maintained or even increased, especially if the Community implement their plan to drop the *ad valorem* tariff on dried legumes to 4·5 per cent in 1972. Clearly the future of bean exports depends on future E.E.C. cereal prices.

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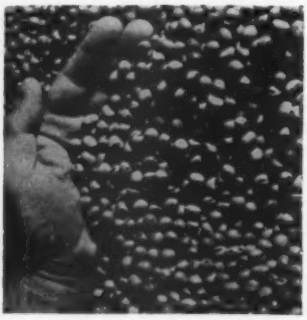
*Agriculture's Import Saving Role. N.E.D.C. H.M.S.O., 1968.

Seed. As demand for seed fluctuates with acreage, the expansion of acreage in recent years has obviously increased the demand. Ministry of Agriculture estimates indicate that approximately 21,000 tons, or 12·3 per cent, of the crop was required for seed in 1967/68 and 21,000 tons, or 9·5 per cent, in 1968/69. These estimates show only total seed requirements and do not indicate the proportion retained by growers themselves. However, data from the growers survey shows that 40 per cent of the acreage was sown with retained seed in 1967/68 and 36 per cent in 1968/69. If these estimates were representative of the total national acreage then only 13,800 tons would be supplied by merchants in 1967/68 and 13,440 in 1968/69. A premium of about £4 per ton was paid for seed beans but crops have to be of high quality and consequently outlets on this market are limited.

Feeding on the farm or sold direct for feed. Traditionally the crop was grown as a source of protein for feeding on the farm. In 1968/69 about 25 per cent of the crop was either fed on the farm of origin or sold direct for animal feed, in addition to the amount taken by compounders.

In the survey seventy-two growers at some stage between 1965 and 1968 fed beans to their own stock. The crop was successfully fed to all classes of cattle, pigs and sheep, but the majority of growers fed their beans to beef cattle. Only fourteen growers had problems and these were mainly mechanical, the most important being slow and difficult grinding, milling or rolling—especially if the crop had upwards of 18 per cent moisture. A number of users maintained that field beans caused greater wear and tear on processing machinery.

Pigeon feed. An unpublished estimate indicates that about 15,000 tons are used in this way, which may be a reasonable approximation. Data from the survey reveals that about 8,000 tons were sold in 1966/67 for the purpose and 13,000 tons in 1967/68. Contracts for this market are limited and unlikely to expand. Good clean small seeded tick varieties are the only types that can be used. A few farmers in the growers survey obtained more than £40 per ton but on average the premium is between £4 and £5 per ton above market price.



A good sample

Compounding performances

Five compounders completed this section of the survey, two of whom were large compounders. One estimated that field beans contributed 0·5 per

cent of total protein crops used in their total production of compounds. Three were smaller country compounders, two using field beans to supply about 6 per cent of their protein requirements in 1966/67 and 6·5 per cent and 17·7 per cent in 1967 and 1968. This possibly confirms that most of the crop sold on the home compound market is used by the smaller compounder and that field beans supply only a minute proportion of the large compounders total crop requirements.

Four compounders gave the following estimated rates of performance:

Table 4 **Rate of performance of field beans**

	Very Good	Good	Average	Fair	Bad
Handling		3	1		
Milling and grinding	1		1	1	1
Mixing		2	1	1	
Rancidity		1	1	2	
Palatability		1	3		
Protein consistency					
(a) Spring variety		3	1		
(b) Winter variety		3		1	

The above table illustrates that the crop is not quite as unsatisfactory as one might think; although milling and grinding is cited as one of the major problems when using the crop, one compounder rated its performance as very good. In fact, none of the compounders gave the crop's milling and grinding performance the same rating; mixing and rancidity ratings also varied between compounders. The differing opinions indicate that compounders may lack experience in using the crop. Many of the problems that are said to exist can be overcome as they use field beans more, that is, provided regular supplies become available at competitive prices.

This article has been contributed jointly by **P. D. Hebblethwaite, M.Sc., N.D.A.,** of the Agriculture and Horticulture Department of the University of Nottingham and **Dr. G. M. Davies, B.Sc.,** of the Department of Agriculture, University College of North Wales, Bangor.

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Schemes for the Inspection and Certification of Growing Crops 1970

Registers of Growers of Certified Stocks

The annual registers of growers of certified stocks of potatoes, fruit tree rootstocks and raspberry canes inspected and certified in respect of health and purity by the Ministry of Agriculture, Fisheries and Food in 1970, are now available. Those for strawberry plants and black currant bushes will be available shortly.

Copies may be obtained, free of charge, on application to Plant Health Branch, Ministry of Agriculture, Fisheries and Food, Horseferry Road, London S.W.1.

The author spent four years as an agricultural adviser overseas and writes about

The Solomon Islands

A. R. Kendrick

IN land area the Solomon Islands Protectorate is the largest British administered territory in the Pacific and comprises a scattered archipelago extending for approximately 900 miles in a south-easterly direction from Bouganville, in the Australian administered territory of Papua and New Guinea, to the Santa Cruz Islands. The total land area is approximately 11,500 square miles.

The six major islands of Choiseul, New Georgia, Santa Ysabel, Guadalcanal, Malaita and San Cristobal form a double chain from Bouganville converging again at San Cristobal about 500 miles distant. These islands are rugged and vary between 90 and 120 miles in length and between 20 and 30 miles in width.

Palm replanting experiment

Typically, the larger islands have a mountainous spine which on one side drops steeply down to sea level and on the other drops through a series of foot hills to a coastal plain of varying width. Mt. Popomanaseu (8,005 ft) on Guadalcanal is the highest named mountain, and on the north-east coast of this island is the only extensive coastal plain in the Protectorate. Except for the coral atolls and the raised coral reefs, the cores of most islands are of igneous and metamorphic rocks overlaid with a considerable thickness of marine sediments. There are extensive coral reefs and lagoons around many of the islands and these form fascinating and attractive stretches of scenery. All the larger islands have an abundance of rivers, the water of which is normally drinkable. Some volcanic activity is experienced; Tinakula, the volcano near Santa Cruz, is active, and earth tremors and tidal waves occur. Hot springs and thermal areas are found in some places.

Climate and vegetation

The climate is wet equatorial but much modified by the surrounding ocean and mountains to give a temperature range between 19 and 35°C. Cyclones 'seed' in the Solomons during the hot season and pass on to the New Hebrides, New Caledonia, Fiji and Australia, increasing in intensity as they go. Occasionally the islands of the group itself suffer from these cyclones.

Rainfall is variable but evenly distributed throughout the year. Averages range from 70 in. a year in the comparatively dry 'rainshadow' area around the capital city Honiara, through a more usual 150 in. to a possible 300 in. or more in the mountain areas. Rain frequently falls as a deluge and 4 in. an hour is not unusual. Generally, rainfall is short and heavy and completely sunless days are rare. For the most part the islands are covered by vast tracts of impenetrable rain forest with towering trees, dense undergrowth and a variety of poisonous plants.

Animal life

Animal life is meagre. Cattle, pigs, dogs and cats have been introduced and wild pigs are fairly numerous and highly prized. The indigenous animals are few and are mainly nocturnal. They include several kinds of phalanger and bats and a variety of species of bush rats and mice. Bird life is varied and includes duck, pigeon, hornbill, megapode, parrots, cockatoos, frigate birds, herons, eagles and hawks. Crocodiles are present in coastal waters and river swamps. Snakes and lizards are common, and a wide variety of species of both can be seen, although snakes seldom attain any considerable size and few have a fatal bite.

Insect life flourishes and includes enormous butterflies and moths of up to 12 in. in wing span, as well as dragon flies, crickets, mosquitoes, sandflies, white ants, scorpions and a particularly nasty poisonous centipede.

Agriculture and development

The Agricultural Department of the Protectorate has set itself a threefold purpose:

1. To increase the production of export crops, thereby increasing the revenue from export duties available for investment in general development projects.
2. To better the diet of the Solomon Islander through improved agricultural varieties and techniques.
3. To introduce cash crops to provide an increasing income to the Islander.

General development in the country is growing, with schools, hospitals, roads and bridges having priority, However, over half the money necessary to balance even a modest budget is derived from Britain's exchequer.With independence already in prospect the need is to increase production dramatically from all sources. Forestry and mineral exploitation have their place but agricultural development will always be of paramount importance in a country of this kind and the Agricultural Department has embarked on an all-out effort to make progress in this direction. Another factor in the drive to increase production is also becoming apparent as a result of vastly improved medical services which have helped to eliminate yaws, control tuberculosis, polio and leprosy and partially control malaria; together with a general improvement in overall treatment in the more remote areas, the result has

been a much higher birth survival rate and large numbers of children abound in all areas. Although present day food supplies are plentiful and pressure on land is low—slightly less than one square mile per person—a continuation of this 'population explosion' will place heavier demands on the Agricultural Department to maintain, yet alone improve, present dietary levels.

Occupied by the Japanese in 1942 and retaken by the allies some time later, grim relics of the Second World War are much in evidence. The biggest legacy of those days is to be seen in the roads, bridges and airfields which were rapidly built by the occupying forces. These have provided the staging from which post-war development has taken place. Recovery was slow, although the people were eager for advancement into the technological age which the allied forces brought with them.

The national economy relies overwhelmingly on the export of copra, production of which is around 25,000 tons per annum. Cocoa is the second major export crop, and yearly production is slowly increasing.

The main subsistence crops grown in the Islands are sweet potato, yams, taro and cassava. Throughout the group these are still largely produced by gardening with the shifting system of cultivation. This is wasteful both of land and timber and a more intensive system of agriculture will be imposed as pressure on land availability increases.

An increasing preference for rice as a staple food is apparent and this has resulted in considerable expansion in the growing of dry rice on the Guadalcanal plains in rotation with sorghum and soya beans.

Copra is the dried kernel of the coconut and is in considerable demand for its valuable oil used in the manufacture of soap and margarine. About half the total annual production is produced by native farmers on relatively small plantations, the rest on much larger plantations owned and managed by overseas interests. Research is directed towards the establishment of standards for fertilizer use, planting densities, weedicide use and the control of insect and fungal pests; the result of this, with a palm breeding programme, is that yields per palm and per acre are increasing.

Similar research work is being done with cocoa; the Agricultural Department buys most of the cocoa beans wet from the farmer and ferments and dries them. Other crops grown include most European type vegetables, salad vegetables, tobacco, groundnuts, peppers, chillies, cotton, cinnamon, nutmeg, cloves, citrus and most tropical fruits. The Commonwealth Development Corporation is presently engaged in the establishment of a large area of oil palms. Considerable expansion in production from all these crops is expected over the next few years.

There has been increasing work undertaken with pigs and cattle, and the fencing subsidy and the regular importation of A.I. heifers from Australia for sale to farmers were a direct cause of this.

Administration of the Agricultural Department

The Solomon Islands are divided into four Administrative Districts and for its own administrative purposes these divisions are also used by the Agricultural Department. In overall charge of each district is an Agricultural Officer. Under him are a number of college trained Field Officers each having charge of a smaller sub-district. Field Officers have in the past always been expatriates, although rapid progress towards the localization of these posts has been achieved over the last five years. Field Assistants with three years

Rice planting in Guadalcanal

training experience at the Department's Agricultural Training College work under the Field Officer. The Field Assistants are normally posted to outstations and are responsible for the day-to-day work in the field. To assist them they each have a number of locally recruited and partially trained Extension Assistants and a small labour force. The total number of staff under control of the Agricultural Officer will vary with the size of district but on average is about seventy. The work of the extension workers is concerned mainly with the drive to increase copra and cocoa production through better husbandry techniques, and the supervision of the coconut planting and re-planting subsidies.

Lack of good road communications means a variety of transportation must be readily available to ensure efficient deployment of manpower and correct phasing of extension programmes. To facilitate this, a fleet of Land Rovers, Volkswagons, motor cycles, canoes and outboard motors and larger sea going vessels are under the control of the A.O. for deployment as he sees fit. Supplies and equipment must also be made available to ensure the satisfactory implementation of policies. At the beginning of each year each A.O. is provided with an allocation of money based partly on his estimated budgetary requirements for that year. With this allocation, or vote, amounting to many thousands of dollars, he is able to hire the staff and buy the equipment necessary to carry out the work of the Department in his district. He also collects the revenue from the sale of many commodities which the Islander would otherwise find difficult to obtain in outlying areas., e.g., rat poison, seeds, fertilizer, coconuts, cattle, etc.

The duties of the A.O. are often wide and varied and in his role as a touring officer he will often find himself involved in aspects of work well removed from his normal routines. Examples of this in which I was involved included the patrolling of an area where hostile natives required some 'flag waving' after the murder of a missionary nurse; the holding of emergency 'native courts' to dispense justice and adjust local grievances, assisting in elections and censuses, and attending Government House meetings.

This article has been contributed by **A. R. Kendrick, B.Sc.** who was formerly an Adviser with the N.A.A.S. in Carmarthen.

Crops are always at risk in frosty weather. This article discusses measures a grower may be able to take to combat

Spring Frosts

W. H. Hogg

FROST in the spring is one of the major hazards for fruit growers and early crop producers in this country. It is very variable in occurrence and several years with little damage may be followed by a spell when some crops are wiped out in three or four years in ten; unfortunately this variation is neither cyclic nor predictable. The past few years have shown a tendency to somewhat later springs, but this does not necessarily imply a greater risk of frost damage, even if the tendency continues. When frost occurs its distribution is often very patchy and some orchards escape serious damage while others lose most of their crop.

In technical terms a frost occurs when the temperature of the air falls below freezing point; this is measured in a Stevenson screen at about four feet above ground. The important distinction for the grower is whether the freezing air is still or whether there is an appreciable wind; in other words, whether it is a radiation frost or a wind frost.

Radiation frosts

Radiation frosts are of local origin and typically occur on still, clear nights. As the sun goes down there is on balance a loss of heat by radiation from the earth's surface, including objects in contact with it such as plants and buildings. The surface gradually cools, in turn cooling the overlying layers of air; if this continues long enough a frost may result. The air temperature on these nights increases upwards to a height above which it follows its more normal pattern and decreases upwards. This is a temperature inversion and its height can sometimes be estimated from the behaviour of rising smoke which tends to spread horizontally when it is trapped beneath the inversion. There is often a marked difference of temperature between the ground and the screen level (4 ft) with visible signs of frost on the ground although the screen temperature is above 0°C. This difference may well amount to 5°C or more and explains why low crops may be damaged while taller ones escape.

The topography markedly affects the distribution of radiation frost. On gentle slopes the cooled air moves slowly downhill to collect in the frost hollows which are known to many growers. Obstructions such as walls and hedges on a slope in the path of the cold air cause it to accumulate and form frost pockets. This downslope movement of air is barely perceptible, in contrast to the movement with wind frosts.

Wind frosts

Wind frosts are imported, usually from the continent on easterly or north-easterly winds; an anticyclone over northern Europe in spring may

well bring a wind frost to Britain. Unlike radiation frosts they often occur in cloudy weather and in early spring may persist throughout day and night. During a typical wind frost the temperature may be only slightly below 0°C but the movement of sub-freezing air over vulnerable buds and shoots can lead to severe damage. The effect of site is less important than for radiation frosts, but as the damage is largely the result of air movement any shelter is beneficial and the sheltered hollows which suffer in radiation frost may be favoured during wind frost.

Choosing the right site

For most of the fruit-growing areas, radiation frosts are considerably more frequent than wind frosts and the characteristics of the site are, therefore, of great importance. The cost of particular sites in terms of lost production may be estimated and the following example is from the Taunton district where black currants are grown on a farm with considerable frost problems. Based on estimates of frost probability over ten years, the likely reduction in gross return is put at £200 per acre, assuming that black currants could be grown without loss from frost in the district. If allowance is made for the regional frost risk, then the loss in annual gross return on the farm is some £66 per acre, which reflects the purely local factors.

For many years growers have tried to prevent or reduce frost damage and clearly it is essential to avoid bad sites when planning new planting. Rough assessments of frost risk can be made from maps and the topography of the district but if time permits a frost survey should be made, under the guidance of the agrometeorologists attached to the National Agricultural Advisory Service. Briefly, minimum temperatures are recorded daily during the spring for one or more years at representative points and are analysed to find the chance of a frost occurring after given dates. For example, the following table gives the results from one of the sites on the Somerset farm mentioned above. The data are given for three temperatures to indicate the frequency of frosts of different intensity.

Number of years in ten when spring frost occurs on or after the stated dates

Temperature	Apr. 1	Apr. 8	Apr. 15	Apr. 22	Apr. 29	May 6	May 13	May 20
0°C	10(9)	10	10	10(6)	10	10	7(1)	6
−1·1°C	7(5)	6	6	6(2)	6	6	4(0)	2
−2·2°C	5(3)	4	4	4(1)	4	3	2(0)	1

The values given in brackets for some dates show the estimated regional frost risk, and clearly the local influences are of major importance.

Much fruit has been planted in areas of high frost risk, sometimes because the best soil is found on the lower slopes of valleys. Theoretically there are a number of ways of preventing frost damage but not all of these can be put to practical advantage. They include the use of fans to bring the warm air above the surface down to the ground, and the provision of a temporary covering over the crop. Experiments made with protein-based non-toxic foams have given protection against frosts of 6–7°C and these may prove to be valuable for covering crops, particularly in protecting against radiation frosts. The two methods most commonly in use are direct heating and the sprinkling of water over crops.

Direct heating

Direct heating of orchards is the older of these methods and its efficiency depends largely on the extent to which the air can be contained within the orchard. It should not be attempted if there is more than a very slight drift of the air and it is more effective if the inversion level is low and acts as a lid to contain the heat below. The use of wax candles has been described in *Agriculture** but with any direct heating there may be problems in providing labour for the lighting and smoke may cause inconvenience. The possibility of gas heating was also mentioned but whatever the technical efficiency of this method its economic value has yet to be assessed.

Sprinkler system

The pioneer work on sprinkling was carried out at East Malling Research Station and subsequent developments have been mainly the improvement of techniques. The method depends on the fact that when water freezes it releases its latent heat of fusion, approximately eighty calories per gram of water; if irrigation equipment is used to sprinkle water continuously over susceptible crops while the temperature is below 0°C the plants benefit from this latent heat as the water freezes. With continuous sprinkling the buds, or fruitlets, are kept at temperatures just below freezing point and normally suffer little damage in spite of the large quantity of ice which may form on the bush or tree. The great advantage of the method is that it can be made automatic, though many growers prefer to keep a watchful eye on the equipment; pumps may fail or sprinklers may be blocked by ice and if these are not quickly rectified the crop may be severely damaged.

The figures quoted above for the Somerset farm suggest that a complete prevention of frost damage may be worth as much as £200 per acre gross return on some sites, which would justify considerable capital expenditure. This might include the provision of a reservoir, the capacity of which would be determined by meteorological factors. For example, it is necessary to know on how many successive nights frosts can occur and the length of time for which air temperature is below freezing; these must be assessed from past data collected at meteorological stations. For Somerset we may take a maximum of six successive nights of frost with an average of ten hours frost per night. If, therefore, sprinkling is required for ten acres and the proposed system supplies 3,000 gallons per acre per hour, a maximum demand of 1·8 million gallons ($6 \times 10 \times 3{,}000 \times 10$) can be expected, assuming, as is likely, there is no effective replenishment of water during this period. The main disadvantage of the method is the quantity of water left on thawing, which may produce temporary waterlogging and affect soil structure. The method is also considerably less efficient when there is any wind and it is of doubtful benefit in a wind frost.

Another method involving the use of water is more suited to crops of a low growth habit such as potatoes. Moist soils are less likely to have a frost than dry soils and irrigation equipment can be used to moisten the top layers of soil when a frost is likely. On a farm in Wiltshire a close liaison is maintained with the nearest forecast office which provides estimates of the air and grass minimum temperatures expected the following night; spraying is not normally considered necessary if the grass minimum temperature is forecast as

* *Agriculture*. January 1970. M. G. Banwell.

above −2°C. The amount of water applied depends on the state of the soil and the time available, varying from ½ inch to about 1½ inches. On one occasion all but seven of forty-five acres of potatoes were protected and some £3,000 was saved.

One of the anomalies resulting from the assessment of frost protection in economic terms is that greatest benefit will be shown by the worst sites because without protection their yields will so frequently be reduced. Such land may be inherently unsuitable for frost susceptible crops and it may best be put to other uses so that the grower is working with the weather and not against it.

This article has been contributed by **W. H. Hogg, M.Sc.**, who is the Senior Meteorological Officer attached to the Ministry's office at Bristol.

Hazards in Farm Buildings

During the winter months many farm activities will be taking place in and around buildings. Some simple precautions taken now can help to prevent accidents. Here are just a few:

Lofts

One essential precaution is to make sure that loft floors are sound and free from defects; broken or missing floorboards can be extremely dangerous. Replace any defective flooring; even if a floor seems to be sound, are you sure it is strong enough for the job? If you are using a loft to store quantities in bulk, and you do not know its safe load-carrying capacity, it is advisable to seek expert advice. A tragic death occurred recently when a loft floor, carrying loose grain, collapsed on top of a farmer working below.

Unguarded loft edges, floor and wall apertures are an invitation to disaster, and are a major cause of serious falls. Guardrails, or fences, will help to prevent such unnecessary accidents. All open loft edges should be fitted with firmly secured rigid guardrails, or fences, throughout their length. If it is necessary to remove a section for the movement of materials, a safe, secure and convenient handhold must be provided for the operator, and the section replaced immediately the job is finished.

If a loft door has to be opened for ventilation or some similar purpose, a guardrail should be fitted between the jambs. When a loft doorway is being used for loading or unloading, a suitably-placed handhold will enable an operator to steady himself.

Stairways

Stairways can be a major hazard, and time spent in checking their condition could well forestall an accident. Worn, damaged, missing or broken treads should be replaced. Do not take chances with temporary repairs. Handrails should be firm and rigid, and wherever possible they should extend the full length of the stairway, with a suitably-placed handhold for getting on or off.

Dust

Accumulations of dust in enclosed buildings can be a potential fire hazard. Now is the time to clean down your buildings and to check that ventilation systems are adequate.

Lighting

Dark and badly lit buildings are a menace to all. So check that your lighting is adequate and replace any light bulbs that are broken or missing. Above all, make sure that the installation is safe. Defective lampholders, switches and worn and frayed wiring can cause not only fire, but death. When you are checking the condition of your installation, have a look at the position of your switches. They should be accessible at both entry and exit points to all workplaces.

Experiments carried out by the National Vegetable Research Station and four N.A.A.S. Experimental Horticulture Stations have provided some interesting conclusions about

Nitrogen Fertilizer Requirements of Brussels Sprouts

D. J. Greenwood **T. J. Cleaver**

Applications of nitrogen fertilizer to Brussels sprouts may have to be modified to meet the changing methods of growing the crop. The demand for small sprout buttons with diameters of between ½ and 1½ in. is increasing and, as is well recognized, high yields of such sprouts can be achieved only if the plants are grown at a space of about 21 in. square compared with the more usual one of about 36 in. square. One consequence of the closer spacing is that a complete crop canopy develops soon after planting which makes it difficult, if not impossible, to apply conventional top dressings in the usual way during the growing season.

But the question may well be asked—are top dressings really necessary? Certainly many experiments with other crops comparing top with base dressings suggest that they may not be. Another consequence of closer spaced plants is that the nutrient uptake is greater and thus fertilizer demands might also be greater.

Collaborative work between the National Vegetable Research Station and the N.A.A.S. Experimental Horticulture Stations at Kirton (Lincs), Luddington (Warwicks) and Stockbridge House (Yorks W.R.) has, therefore, been carried out to find how much and how best to apply nitrogen fertilizer to close spaced Brussels sprouts. We are greatly indebted to the technical staff at these stations for carrying out most of the experimental work on which this report is based; in particular Mr. M. B. Wood (Stockbridge House), Mr. J. D. Whitwell (Kirton), Mr. J. B. Williams and Miss J. M. Garthwaite (Luddington).

Field Experiments

Sixteen field experiments were carried out from 1966-69 at the four centres. Ammonium nitrate based fertilizers were used. Plants were transplanted to a spacing of 21 × 21 in. and crops were harvested at a single picking between mid-September and mid-February. In some experiments different amounts of nitrogen were applied in various proportions as base dressing immediately before planting and as top dressing at the end of July. The average yields are given in Table 1.

The highest of the yields obtained when all of the nitrogen was applied as base dressing was similar to that obtained with the best combination of base and top dressing. When a quarter of the nitrogen was applied as top dressing yields were similar to those obtained with all the nitrogen as base dressing, but yields were less when more of the nitrogen was applied as top dressing and less in the base. Experiments to find the best time of application showed that when top dressings were applied later they were less effective in increasing yields. Thus, if sufficient nitrogen was applied as a base dressing there was no need for any top dressing. We will, therefore, confine our subsequent discussion to the results obtained when all the nitrogen was applied as base dressing.

Nitrogen had no effect on the incidence of internal browning, the firmness or the smoothness of sprouts. High rates of nitrogen slightly increased lodging, and when applied at the rate of 500 units or more sometimes increased the death rate at transplanting. The level of base dressing of nitrogen over the range 0-600 units per acre had little influence on the percentage (about 70) of the total weight of sprouts having the preferred diameters of between $\frac{5}{8}$ and $1\frac{1}{2}$ in. (Table 2). Over the practical range of application, 150 to 450 units, the proportion of sprouts in any of the size grades was unaffected. Thus nitrogen fertilizers had little effect on any aspect of sprout quality.

Table 1

Yield of marketable sprouts (tons/acre)

Percentage of Nitrogen applied as		*Units of N*					
base dressing	*top dressing*	0	100	200	300	400	500
100	0	3·3	4·9	5·9	6·2	5·4	5·1
75	25	—	4·7	6·0	6·3	6·1	5·3
50	50	—	4·6	5·6	5·6	5·8	5·0
25	75	—	4·5	5·0	5·4	4·7	—
0	100	—	4·6	4·6	—	—	—

Table 2

Size distribution of sprouts

Base dressing (units N per acre)	*Percentage of sprouts in size ranges*				*Waste*
	< $\frac{5}{8}$ in	$\frac{5}{8}$ – 1 in	1 – 1 $\frac{1}{2}$ in	> 1$\frac{1}{2}$ in	
0	10	49	21	2	18
150	3	35	37	4	21
300	3	30	36	4	26
450	3	32	34	4	28
600	3	31	37	4	26

Effect on yield

In each of the sixteen experiments the yield increased rapidly at first, reached a maximum, and then decreased slowly with increasing levels of nitrogen fertilizer. Over the sixteen experiments the yield, on average, was 3·2 tons when no nitrogen was applied, reached a maximum of 6·2 tons with 270 units and fell to 5·4 tons with 534 units (see Fig. 1). The level of nitrogen

giving maximum yield, however, varied on these fertile soils between experiments; in some it was no application whereas in others it was 450 units.

These differences in response were not associated with the variety or with the date of harvesting but appeared to be associated with the weather conditions, because in successive years at the same centre the optimum application of nitrogen fertilizer fluctuated by more than 150 units. Decomposition of soil organic matter could not account for the differences, as this would release only about 25 units of nitrogen in an average growing season.

It seems likely that the amounts of residual nitrogen fertilizer in the soil from applications to the previous crop varied, and it is certain that the water regimes during crop growth, which can influence the effectiveness of fertilizer, varied in different years. The precise effect of these, and other factors, however, is not known and there remains an apparently random element in the response of Brussels sprouts to nitrogen fertilizer.

We can, nevertheless, make use of the features of the response which were common to all experiments to forecast the most satisfactory levels of fertilizer for different sets of circumstances. The prime concern may be to obtain the maximum possible production over a number of years and such factors as the variation in yield from one year to the next, or the risk of occasionally getting low yields, may be of less importance. In these circumstances, the best estimate from our experiments of the optimum nitrogen level would be the level giving the highest average yield, namely 270 units.

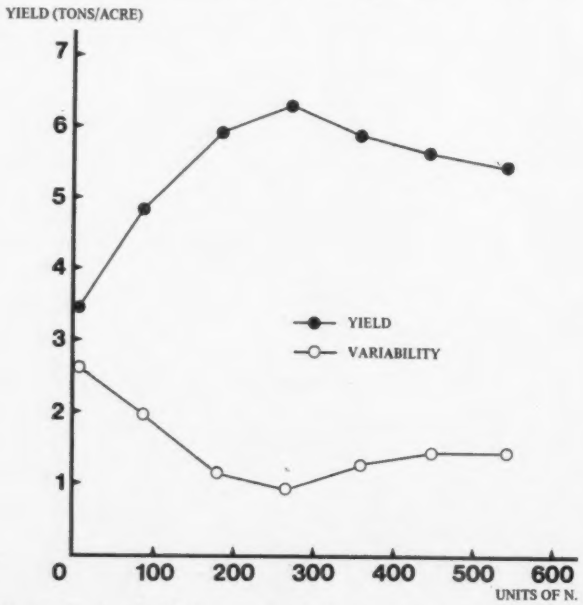


Fig. 1. Variability is calculated as the standard error of variation in yield between different experiments

Yield variations

On the other hand, the converse might hold good and it may be more important to get as predictable and as constant a yield from one year to the

next than to maximize the overall production. A graph (Fig. 1) was, therefore, plotted of variation in yield (between experiments) against level of nitrogen base dressing. The graph was almost a 'mirror image' of the response curve with variability being greatest with no application, decreasing to a minimum and then rising as the nitrogen applications increased. Minimum variability occurred with 270 units. Thus the two quite different approaches both gave the same result although they might well have been expected to give different ones.

The cost of fertilizer is small compared with the value of the crop so the 270 units of nitrogen per acre would also be the economic optimum. With this application yields in seven cases out of ten would be within 10 per cent of the highest that could be achieved with any base dressing. This level of uncertainty, though not satisfactory, is bound to remain until reasons for the variability can be identified.

Conclusions

Our main conclusions are that the level of nitrogen fertilizer had little effect on the size or quality of sprouts, that top dressings were unnecessary if sufficient base dressing was applied and that the optimum base dressing was about 270 units. They should apply to soils of similar types to those on which the experiments were carried out. These soils contained less than 2 per cent organic carbon and ranged in texture from a very fine loam to a loamy coarse sand and are thus representative of many that are used for Brussels sprout production. Leaching of nitrogen from heavier soils is less, which suggests that the main conclusions might also apply to them.

In other experiments drilled crops responded to nitrogen in an almost identical manner to transplanted crops but there was a tendency for the nitrogen fertilizers to increase salt concentration around the seed sufficiently to depress emergence. Thus with drilled crops it appears that as much nitrogen should be applied in the base dressing as is possible without appreciably reducing the stand, and the difference between this and 270 units should be applied as a top dressing after emergence. In our experience the most satistory subdivision was about 100 units as base dressing and 170 units five weeks later.

This article has been contributed jointly by **D. J. Greenwood, B.Sc., Ph.D.** and **T. J. Cleaver,** of the National Vegetable Research Station, Wellesbourne, Warwickshire.

The Game Conservancy "Approved Scheme"

The shooting man now has his own form of consumer research. Known as the "Approved Scheme", it is modelled on that run so successfully by the Design Centre. The Conservancy will lend its name as a seal of approval to selected and tested products.

For over thirty years the Conservancy's Research Station at Fordingbridge has developed rearing and feeding equipment, tested drugs, formulated game foods, invented game-marking devices and so on—as a general contribution to game management. In addition to the more technical items under trial, the field staff themselves use almost every item of equipment normally employed on a shoot throughout the year. Now this "testing" has become an official part of the operational work of the Game Conservancy.

The criteria for an award will be that the product is entirely suitable for the purpose for which it is sold, is of good quality and design, and above all proves reliable in use. This should be an attractive marketing asset to manufacturers and a useful guide to purchasers. A variety of products are currently undergoing trials at Fordingbridge.

Roadside tree planting on the Thorpe Morieux Estate

Tree Planting in East Anglia

F. W. Meade

OVER THE last few years the pattern of some of our countryside has been changing rapidly, with our agricultural industry striving for increased efficiency in the face of higher costs, lower product prices and a decreasing labour force. As a result of these pressures, and to make units of a size and shape which modern machinery can work effectively, many farmers have been busy grubbing out hedges, bulldozing woods and filling in ponds.

A number of farmers are, however, conscious of the importance of preserving the heritage of the countryside passed on to us by our forefathers. Strutt and Parker (Farms) Ltd., who occupy over 20,000 acres in East Anglia, is numbered among them. On the Thorpe Morieux estate, near the medieval wool town of Lavenham, Suffolk, a policy of tree planting is being carried out for amenity and sporting purposes. This work was started four years ago and consists of two separate types of planting.

Amenity

The first is purely for amenity, consisting of the planting of trees—sycamore, oak, elm and ash—alongside the roads through the estate, and poplars and willows on the banks of a small stream. The trees are planted at intervals of 30—40 ft, each being individually staked and wrapped with paper or pieces of fertilizer bags to a height of 2 ft as protection against damage from hares and rabbits. This improvement began with left-over saplings from other plantings but has now been extended so that some three miles of roadside have been embellished. Even at this early stage they form an attractive feature along the narrow Suffolk lanes.

Small spinneys

The other type of planting is of small spinneys in odd corners which are of little use for farming. These vary in size from one-half to three acres and to

date twelve acres have been planted in this way. They are mainly mixed plantings of small groups of oak, beech, sycamore and ash among either Corsican or Scots pine, but some areas have been planted with Norway spruce on its own and one acre is taken up by holly trees.

Plantation maintenance

The plantations are all fenced round against vermin and are planted at a 6 × 4 ft spacing except for the holly for which 6 × 6 ft spacing was used. The hardwoods are in groups of five at intervals of 8 to 9 yards, thus helping to reduce the uniform appearance which 'straight' plantings of conifers give. Weeding is carried out each year as necessary: vegetation between the rows is cut mechanically and rubbish round the trees controlled by a weed-killer.

All this work is carried out by two of the estate employees, J. Cobbold and J. Smith, who also work with the estate maintenance and building staff. These two men, who are more interested in trees than tractors, are the main inspiration behind the planting programme, backed by the Hon. J. A. Davidson, a director of the company, who lives on the estate. They have found out for themselves a lot about silviculture, including the fact that it is necessary to plant one male holly tree to fifty females, in order to be certain of producing berries.

Effect on field sizes

While this planting programme has been going on field sizes have been increased by removing hedges. This is necessary on a unit of this size—nearly 2,000 acres—of which the only stock are two dairy herds totalling about 370 cows and their followers. The field sizes now range from 4 to 147 acres with the smaller being down to grass; the arable fields average around 30 acres in size.

Mr. Davidson considers that about 40 acres is the best field size for cropping purposes; those over this are often split between different crops. When fields get too large other problems can outweigh the savings in hedge maintenance etc., especially on the heavy chalky boulder clays of Suffolk. Soils are often not uniform over large areas, leading to problems with timing of cultivation. Drainage can also cause trouble, with burst pipes and so forth, the results of which are far worse in a large enclosure. Finally, large enclosures can present the men who have to work long rows with problems like timing of operations to fit in with meal breaks and the monotony of the work.

To sum up, this can be claimed as a useful and worthwhile project. Not only will it improve the amenity of the countryside generally but should also provide habitats for wild life to replace some of those lost by the removal of hedges in forming larger fields.

Decimal Currency

15th February 1971 is D Day. To help farmers and growers to understand how this will affect the completion of claim forms, calculation of payments, etc., an explanatory leaflet *Points for Farmers and Growers* is being sent by the Ministry to all farmers and growers in England and Wales.

Controlling Dimensions For Farm Buildings

THE article printed on pages 576–7 of the December 1970 issue of *Agriculture* described the recommendations for the controlling dimensions for farm buildings resulting from a study carried out by the A.L.S. and discussions with designers, manufacturers and users. The following diagrams support that article in detail.

Preference Weighting is indicated thus:

● First ● Second • Third ■ Bay spacing

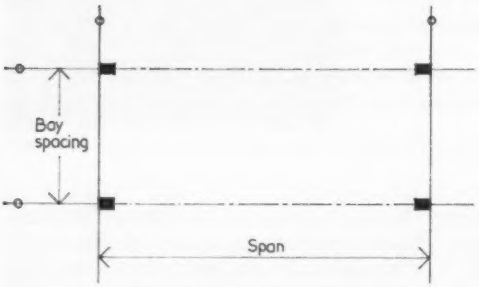


Diagram A.

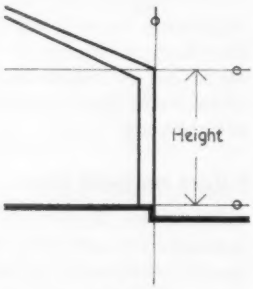


Diagram B.

Diagram A. Horizontal spacing of structural zones.

Controlling lines:

Span to be outer faces of structural zones.

Length or bay spacing to be centre lines of structural zones.

Preference weighting:

m	m	m	m
2·4	4·8	9·0	15·6
2·7	5·4	9·6	16·8
3·0	6·0	10·2	18·0
3·3	6·3	10·8	19·2
3·6	6·6	11·4	19·8
3·9	7·2	12·0	20·4
4·2	7·8	13·2	21·6
4·5	8·4	14·4	

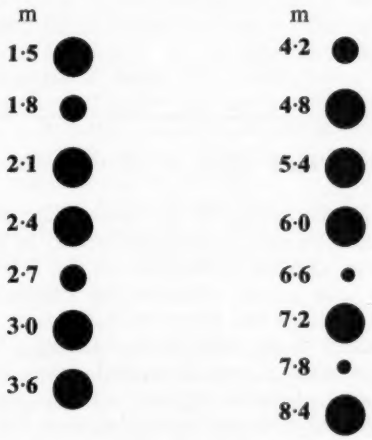
Diagram B. Principal vertical dimensions.

Height:

Lower plane to be floor level or highest ground level.

Upper plane to be through the intersection of upper plane of roof structural zone, i.e., top of purlins or equivalent structural members, either horizontal or inclined, and the external fall of vertical structural zone.

Preference weighting:



In the case of both diagrams upper limits of preference weighting may be extended in increments of 1·2 m.

Milk and Milk Products Technical Advisory Committee

The annual report of the Milk and Milk Products Technical Advisory Committee for 1969-70 has been presented to the Minister of Agriculture, Fisheries and Food and the Secretary of State for Scotland and has been published.

The Committee, which was appointed in 1954, had the following terms of reference; 'To keep under review the technical problems arising at all stages of the handling, processing and distribution of milk and the manufacture of milk products; to inform Ministers of the problems requiring research and of desirable technical developments, and to advise on the best means of encouraging the adoption of such developments in the dairy industry.'

The Committee has continued to keep under review various technical matters arising in the dairy industry. These include the possible use of dye-markers to enable antibiotic residues in milk to be more easily detected, the production of U.H.T. milk by the method of direct steam injection, the mechanization of cheesemaking, research on rennet substitute for cheesemaking, and certain problems arising from the use of milk powder for infant feeding.

Copies of the report are available from the Ministry of Agriculture, Fisheries and Food, Publications Branch, Tolcarne Drive, Pinner, Middlesex, HA5 2DT, price 1*s.* (by post 1*s.* 4*d.*).

42. Surrey

H. E. Shaw

SURREY is quite a small county with considerable scenic beauty and a wide range of soil types.

As the population is slightly over one million, and the distance between the furthermost town and London immediately to the north is only forty-two miles, there are very heavy demands on the 416,000 acres in the county. These factors have greatly influenced agriculture and horticulture on the 165,400 acres of crops and grass and 6,200 acres of rough grazing, which together represent 40 per cent of the total area. The public has a right of access to 23,000 acres of non-agricultural common land, including National Trust and County Council commons which range from the picturesque greens to large areas of several hundred acres in this heavily wooded county. The county can conveniently be divided into three main sections.

The North Downs

The most prominent geological feature is the line of the North Downs which rises to 740 feet and runs through the middle of Surrey from east to west, terminating in the narrow Hog's Back on the outskirts of Farnham and which, throughout its length, presents a steep escarpment to the south. Guildford is situated in the gap formed by the river Wey, and Dorking lies in the river Mole gap. Farms are larger than average on the chalk soils and on the clay with flints, the latter being mainly on the wider eastern end of the Downs extending to the boundary between the county and the Greater London Boroughs of Croydon and Sutton. There are also areas of acid sand on which heath and woodland are found.

North of the Downs

In the north-west of the county are the poor, light acid soils of the Bagshot Beds, which are very indifferent for farming purposes but well suited for the production of nursery stock. The largest single nursery stock-producing area in the county is located to the north and west of Woking. An extensive area of heathland in the Pirbright, Frimley and Bagshot locality adjoining Hampshire is used for military training purposes. It is here that the well known Bisley shooting ranges are situated.

The greater part of the remainder of the county north of the Downs is on London Clay with overlying deposits which vary considerably in texture from light loam to heavy clay.

In the extreme north, on the sands and gravels of the Thames terraces, there are numerous horticultural holdings producing mainly salad crops and vegetables. Many holdings have an area of glass for the production of lettuce, tomatoes and flowers.

South of the Downs

The Lower Greensand is separated from the chalk by a narrow band of gault clay and occupies the greater part of the south-west of the county, tapering towards the east. Much of the Greensand is under heath and woodland and along its southern fringe it rises to form a ridge of hills running from Hindhead (895 ft) to Leith Hill (965 ft) near Dorking, the highest point in the south of England. A large tract of the Lower Greensand is very variable in character and of rather low fertility. The most favoured part of the formation is a circumscribed area on the Bargate Beds to the west of Godalming which, with the aid of irrigation, lends itself to market gardening and field scale vegetable and salad crops.

To the south of the Greensand is the Weald Clay, a relatively flat, heavily wooded and naturally poorly drained area where grassland dairying predominates and where there are many small fields and narrow copses or rews.

Grass and dairying

Two-thirds of the total farm area in Surrey is in grass, and dairying is the most important enterprise. The Friesian is the most popular breed but there are numerous Channel Island herds. The average herd size is fifty-four cows. In June 1969 there were forty-four holdings with herds of more than 100 cows, including seven with over 200. Farms are generally well provided with mains services. Sixty per cent of the herds are parlour milked and an appreciable and increasing number of herds are winter housed in cubicles. Forty per cent of the dairy farms have bulk milk tanks. Intensive stocking, high rates of nitrogen, paddock grazing and silage self-feeding are widely practised, as is the winter feeding of wet grains from London breweries.

Interest in good grassland management has been encouraged by the very active Surrey Grassland Society which was formed sixteen years ago. Although a high proportion of the grassland is well managed there is a considerable acreage, mostly in small fields, which is relatively unproductive, being used for amenity purposes and often supporting only a few riding horses.

Pigs, poultry and arable crops

Pigs and/or poultry are major enterprises on one-fifth of the commercial agricultural holdings. A high proportion of the eggs produced in the county are sold direct to the consumer at premium prices.

Three-quarters of the tillage area is in cereals, of which seventy-eight per cent is barley. Horticultural crops, grown mainly on specialized holdings, total 6,400 acres and approximately half of this area is in vegetables, the most important being lettuce, other salad crops and brassicae.

A wide range of hardy nursery stock plants, especially ornamentals, are grown on 2,100 acres and the 130 acres under glass in the county are used for the production of tomatoes, lettuce, pot plants, flowers and bedding plants.

The farmers

Most Surrey farmers depend on farming for their livelihood but a number of farms are occupied by business or professional men, many of whom employ managers on well equipped units and apply modern techniques in management in addition to enjoying the amenities of living in rural surroundings. Others choose to practise relatively extensive farming systems, often on the smaller residential type of holding. Although numerous farmers and horticulturists benefit from the ready demand for door-to-door sales of cream, eggs, poultry and horticultural produce, pressures on the industry, and especially the competition for labour, are such that units continue to increase in size in order to obtain higher productivity. Up-to-date methods will undoubtedly continue to be quickly adopted by the many progressive farmers in this area of high cost land where town and country are so closely integrated.

Ministry Publications

Since the list published in the December 1970 issue of *Agriculture* (p. 528) the following publications have been issued.

MAJOR PUBLICATIONS

OUT OF SERIES

Aids to Management No. 8 Dairying (Revised) 4*s*. (by post 4*s*. 4*d*.)
(SBN 11 240948 2)

Use of Fluoroacetamide and Sodium Fluoroacetate as Rodenticides, Precautionary Measures (New) 1*s*. (by post 1*s*. 4*d*.)
(SBN 11 240928 8)

Experimental Husbandry No. 19 (New) 9*s*. 6*d*. (by post 10*s*.)
(SBN 11 240789 7)

Northern Pennines Rural Development Board First Annual Report to 31st March 1970 (Chairman: T. J. Cowen.) (New) 4*s*. 6*d*. (by post 4*s*. 10*d*.)
(SBN 11 880112 0)

The following publication is available only from the Ministry of Agriculture, Fisheries and Food (Publications), Tolcarne Drive, Pinner, Middlesex HA5 2DT (not for re-sale).

Milk and Milk Products Technical Advisory Annual Report 1969/70 (New) 1*s*. (by post 1*s*. 4*d*.)

FREE ISSUES (see also page 13)

ADVISORY LEAFLET

No. 572 Fowl Pest Control (New)

SHORT TERM LEAFLETS

No. 109 Stawberry Mite (New)
No. 110 Sciarids on Pot Plants (New)
No. 112 Liquid Fertilizers (New)

UN-NUMBERED LEAFLET

Field Drainage Grants (Revised)

Priced publications are obtainable from Government Bookshops (addresses on p. 48) or through any bookseller. Single copies of the free items are obtainable from the Ministry of Agriculture, Fisheries and Food (Publications), Tolcarne Drive, Pinner, Middlesex HA5 2DT.

in brief

- **Tractor future**
- **Pattern for pigs**
- **Learning to work together**

Tractor future

OF ALL INNOVATIONS that have raised British farming to its present high level of productivity, the tractor must take pride of place for its motive power and multifarious uses on large and small farms alike. Its impressive evolution from the rudimentary models of fifty years ago, restricted as they were by innumerable problems of terrain, soil conditions and climate, reflects the research and ingenuity of successive generations of mechanical engineers. To these, special purpose self-propelled machines have been added in increasing numbers during the past fifteen years, overtaking some aspects of tractor use (although at a higher capital cost). But in the field of land preparation, planting and cultivating the tractor, with its higher horse-power and greater functional efficiency, continues to hold its dominant position.

In his paper read to the London conference on agricultural and allied industrial tractors, organized jointly by the Institution of Mechanical Engineers and the Institution of Agricultural Engineers, Mr. C. L. Baker of Massey-Ferguson, sought to foresee the likely trends in tractor development in the course of the next ten to fifteen years. New ideas, new products and new processes are constantly presenting technical change to the engineer engaged in research and development, unfolding an evolution which though seen to have a beginning has no pre-determined end. In the past technical developments have largely been concentrated on the greater efficiency of the tractor, but today other aspects, such as serviceability, safety, operating conditions and questions of pollution by engine emission, are assuming greater significance. 'The environment in which we work has changed, and the next ten years will demonstrate this in both agricultural and industrial tractors,' said Mr. Baker. 'There is social awareness of our environment and an open recognition in many areas that in a free competitive society government regulation of a consumer product is sometimes required . . . Safety and anti-pollution requirements will be legislated and must be met.'

Mr. Baker sees the legal requirement for safety frames to be fitted to new tractors as only the first step. If the frame is to be fully effective, he said, the driver must be further safeguarded by a seat belt or similar harness. Noise problems must be solved, and Mr. Baker thought that by the mid-'seventies some countries will require the noise level to which the operator is subjected to be not greater than 90 decibels. The all-importance of reliability as the complexity of tractors increases is emphasized by dealers' lack of sufficient skilled servicemen, and by the same token the designer is required to make normal maintainance and overhaul as simple and quick as possible.

Summarizing, in Mr. Baker's view the most probable course of tractor development over the next ten to fifteen years is the application of known technology providing continued evolution; but, he said, 'if an alternative to the high horse-

power requirement for land preparation is found practical, then the present evolutionary trend in tractor design could alter drastically'.

Pattern for pigs

EMERGING from the 'sixties the pig farming industry is seen to be flexing its muscles in encouraging growth. The pattern of small-scale production which once dominated a sagging market is undergoing rapid change as the industry is polarized into fewer units and larger herds—a pattern that has already hardened in dairy farming. To quote a recent figure, one-fifth of our pig enterprises now account for three-quarters of the total production, with an average of ninety-six pigs per herd. At the same time we see the pig population of England and Wales increased in the past two years by half a million to its present 6·5 million, and from the High Street shopper there is a rising demand for more pork and processed pig meat. Nearly one-third of our total meat consumption is at present coming from the pig, and it is noteworthy that F.M.C.'s campaign to put more British bacon on the breakfast table is to be stepped up.

Getting back to first principles, therefore, the strongest possible emphasis must be placed on pig improvement, whereby genetically superior material flows from testing station to fattening farmer, coupled with the assurance of prices that are satisfactory to all links in the chain; and that also includes the consumer, whose purse is the ultimate arbiter. Closely organized production from breeding to point of slaughter is a trend already clearly manifest, with feed firms well to the fore with advanced programmes. Future breed improvement of the commercial pig will doubtless tend to rest in fewer hands, whether breeding companies, co-operative, farmer-breeder consortiums or enterprising individuals, but all are in a wide sense servant as well as supplier. It is the top-quality end product economically produced and economically marketed that engenders confidence all along the chain of production and is finally accepted over the retail counter.

Learning to work together

A SUCCESS story in co-operative silage-making comes from Mid. Wales, where three farmers have found that a better quality feed in greater quantity and with proportionately less effort and expense can be obtained by pooling their resources of capital and labour. Mr. Evan Lloyd farms 210 acres, on which he grows barley and fattens beef semi-intensively in paddocks; Mr. Gwynant Edwards has 180 acres, on which he keeps 60 milkers and followers and 160 breeding ewes; and Mr. Dafydd Griffiths, with 150 acres, has forty cows in milk plus followers and fifty ewes. All three have just one paid farm worker each. A Central Council grant towards a £1,000 investment enabled them to acquire, *inter alia*, a tough rotary mower and a heavy duty double-chop forage harvester to replace the two light-weight tools they already possessed; and added to this a progressive cropping and fertilizer programme was calculated to produce a greater volume of silage, so raising the potential of their land to carry more cattle.

The first year's operation has produced 1,000 tons of good quality silage, cut in ten days over a total of 111 acres—a result that is already seen as a springboard to further improvements in mechanization and perhaps, ultimately, to total integration.

ACKNOWLEDGMENT OF PHOTOGRAPHS

We gratefully acknowledge permission to use the following photographs:

Cover, B.P. Chemicals Ltd: P. 5 A. G. D. Heath: P. 11 Corporation of London: Pp. 15 and 18 J. E. Whybrew: Pp. 19 and 22 J. H. Jones: Pp. 24 and 27 A. R. Kendrick: P. 36 F. W. Meade.

Books

The Principles and Practice of Farm Valuations by LESLIE S. WOOD. Seventh edition revised by E. G. WENHAM and HAROLD SEAGO. The Estates Gazette Ltd., 1970. 50*s*. [£2·50].

Tenant right valuations have always been a mysterious business. The experts who are steeped in the lore of the 'custom of the country' guard the secrets of their craft jealously. My own tutor, dressed invariably in check breeches and calf skin leggings, was reluctant even to reveal his methods to his pupils. The need, therefore, for a good text-book on this subject is great and since Leslie Woods produced the first edition sixty-nine years ago it has been the standard work on the subject. As a text-book for students this seventh edition by E. G. Wenham and Harold Seago is a very useful tool.

It is still, however, a little dusty and archaic in its terms and dwells perhaps unduly on history. In these days of imminent metrication, are Roods and Perches still very relevant? Are many haystacks thatched? And is the space given to the valuation of mangels fully justified? The tone is perhaps illustrated by the use of such phrases as 'all labour which an outgoing tenant has properly bestowed on the land'.

It is not surprising perhaps that some problems are not dealt with too fully on the basis that they are probably local ones. Hops are not mentioned and the serious dilapidation which can result from eelworm infestation, though mentioned, would benefit from a longer discourse. The modern problem of damage to soil structure by overdosing with slurry could also be discussed with advantage.

I hope too that any future edition will have a chapter on rental valuation. On this subject, although it is impossible to be dogmatic, the authors' experience entitles them to lay down guide lines in this largely uncharted area.

Despite these minor complaints of omission this book ought to be read by every student of farm valuations. It deals well with the law of the subject and describes carefully the practical methods which may be employed to set about a valuation. It recognizes, of course, that the appraisal itself is a matter which no text-book can teach.

J.D.F.

The Agricultural State of the Kingdom, 1816. Adams and Dart, 1970. 70*s*. [£3·50].

Compiled from replies 'of many of the most opulent and intelligent landholders' to a circular letter sent by the Board of Agriculture to every part of England, Wales and Scotland, this remarkable summary—factual and stark as a documentary film—gives a comprehensive account of the miseries of a depressed agriculture.

In spite of relatively free access to the wheat lands of North America, British farmers made a vital contribution to food production during the Napoleonic War. This foreshadowed the role agriculture was to play again and again during the succeeding century and a half. The depression following the successful outcome of protracted hostilities is graphically described in the reports first published in 1816. Not unexpectedly, bad times had affected cereal growers first but soon spread to cause dismay amongst mixed and grassland farmers.

Familiar spectres presented themselves; farms were given up by their tenants and could not be let, leaving them in unwilling owners' hands; many left the land altogether, some absconding in their haste to get away; bank loans were called in; rent, tithes and taxes could not be paid. Legal remedies took their unfruitful courses and arrests and imprisonments for debts were commonplace. Prosperous men became paupers and the Poor Rates increased alarmingly. Traditional palliatives were tried; rent rebated or remitted altogether; wages were lowered, or less intensive systems of husbandry adopted. No wonder 'the farmers are to a man dispirited, gloomy and discontented', and an added *cri de coeur*—'and with us the country gentleman is no opulent character'.

Gordon Mingay, Professor of Agrarian History in the University of Kent, provides an admirable Introduction which sets the scene perfectly, and wisely leaves the reports to speak for themselves. Together they make a fascinating human document—all written by country people in the simple and elegant language of the time.

R.G.A.L.

Long Ashton Research Station Report for 1969, £1.

In the director's introduction, Professor J. P. Hudson explains that one of Long Ashton's long-term aims is to achieve a better understanding of the complex relations between plant and environment, for only by exploiting those combinations of soil, topography and climate that are unique to Britain, can the British fruit grower obtain a competitive advantage over his Continental rivals in the open market.

Now that the winds of change are blowing strongly through our orchards and fruit plantations, growers who have not yet discovered how helpful research station reports can be, should find this one stimulating reading—and excellent value for money. It contains much useful information about progress in fruit breeding and nutrition, growth control techniques, methods of combating pests and diseases, plus reports on willows, cider and fruit juice production and domestic food preservation.

The pollination project, in which a hundred growers collaborated with Long Ashton scientists in 1969, confirmed the 1968 findings that inadequate pollination is significantly depressing apple yields. Seventy per cent of the eighty-five Cox orchards investigated and 31 per cent of the sixteen Bramley orchards failed to reach the optimum level of fruit set. A bulletin summarizing all available information and suggesting remedial measures is being prepared.

Besides improving orchard productivity, better fruit set achieved by controlled pollination may also help to overcome the wild fluctuations in annual output which, till now, have hampered planning and marketing. Professor Hudson urges the apple industry to examine the economic consequences. The trial of thirty-six clones of Cox's planted in 1965/66 has shown that many of the Cox clones in commercial cultivation are not the best available. Since genetic differences are thought to be the main source of variation there should be considerable scope for improvement by clonal selection. Five hundred virus-tested Cox's on MM 106 planted at 18 × 36 in. spacing averaged 4 tons per acre, the best trees giving 16 tons per acre. Even closer spacing is now being tested in a 'meadow orchard' of 350 Lord Lambourne and Egremont Russet on MM 106, planted at 12 × 18 in. spacing in 6 ft wide beds.

New topics being studied include a re-examination of the plum growing industry, a technique for assessing the maximum size to which strawberry fruit can grow and developments in multi-purpose solid-set irrigation.

S.L.

Pig Housing. DAVID SAINSBURY. Farming Press Ltd., 1970. £2.

This book is written by a pig enthusiast—who is also a veterinary surgeon—for other pig enthusiasts. In dealing with veterinary matters Dr. Sainsbury speaks with great authority and the chapter on the environmental needs of the pig is a valuable distillation of all the work which he and others have carried out on this subject.

There is a very brief chapter on disinfection routine which could, with benefit, have been expanded. The rather cursory description of the generation of formaldehyde gas by the addition of liquid formalin to potassium permanganate crystals, which causes 'the compounds to re-act with violence', certainly scared this reviewer!

In dealing with the design of piggeries the book brings together and comments upon many of the ideas which have been thrown up over the past twenty-five years in such profusion by a multitude of practical pig farmers.

The reader who seeks with interest the author's views on the 'sweat box' piggery will find the problems involved have been circumnavigated with great delicacy; indeed it is referred to much more politely as a Turkish Bath piggery!

So far as building construction is concerned, the author's views are those of a very well-informed and very keen amateur. This has an advantage in that the prejudices of the professional are absent, although it does not always compensate for the professional's extra experience. This is perhaps most evident in the final chapter on future trends in pig housing. The very sensible plea made for standardization and prefabrication gives little credit to the great strides which have already been made by a number of manufacturers in this direction.

However, this is certainly a good book to guide the intending pig keeper through the maze of pig housing ideas that abound, and to convert him to that degree of zeal which seems to be the hallmark of the true pig farmer.

J.D.F.

The Draining of the Somerset Levels. MICHAEL WILLIAMS. Cambridge University Press, 1970. £6.

First impressions of the Somerset Levels or Moors can be quite misleading. Almost everyone with a knowledge of agriculture or land drainage wishes, at first sight, that something could be done to change the character of the area. They have in mind the low water levels and intensive arable farming of the East Coast Fens. But the men of the Moors enjoy a standard of living, or rather a way of life, which many would envy and they have successfully resisted well meaning attempts to change this, just as their ancestors successfully resisted the Barons, the Church and even the Crown when their way of life was threatened.

These Moors comprise about 160,000 acres of flat land lying mainly between 10 ft and 20 ft above mean sea level in the Bristol Channel. The greater part is covered by low fen or raised bog peats, which in turn are overlain on the landward side by alluvial silt and in a wide belt along the coast by a ridge of marine clay rising to 25 ft above mean sea level. Ridges of the surrounding hills extend into the Moors like fingers and there are a number of 'Islands', some of which rise barely perceptibly above the surrounding ground. They have, particularly in summer, a picturesque acquatic beauty all their own, innumerable ditches brim full of penned water and bordered by willows, with the ridges and hills ever present in the near distance.

The early Lake Land dwellers of the Iron Age used the environment for fishing and fowling rather than trying to change it. Later on the solitude, tranquillity and relative safety of the 'Islands' attracted the early Celtic Christian Church and between the fifth and tenth centuries many Monasteries were established. Subsequently their estates extended well into the Moors. It is little wonder that Alfred used these 'Islands' as a refuge against the Danes. As time passed the very high value of the summer grazing on the drier fringes began to be appreciated and piece-meal reclamation works began in order to extend these.

The Author is at present Senior Lecturer at Adelaide University and he became interested in the Moors while he was at Swansea University and later at London. He gives us a fascinating history of the development of the area. It reads almost like a novel and he brings into sharp focus the peoples concerned and their way of life. Quotations are numerous and the book is well but unobtrusively documented.

T.G.B.

books received

Goat Husbandry. New Edition. David Mackenzie. Faber and Faber Ltd., 1970. 75*s*.

Milk Production '69. The Milk Marketing Boards in Scotland. 12*s*.

Hydroponics. The Bengal System. Fourth Edition. J. Sholto Douglas. Oxford University Press, 1970. 18*s*.

An Evaluation of Losses in Cattle and Sheep Production (with particular reference to Exeter Province). V. H. Beynon. Agricultural Economics Unit, University of Exeter, 1970. 6*s*.

The British Isles Tomato Survey. Second Report: 1967 *Crop*. J. A. H. Nicholson. Copies from School of Rural Economics and Related Studies, Wye College, Ashford, Kent. 1970. 10*s*. post free.

Report of the School of Agriculture 1969-1970. University of Nottingham. 10*s*.

Survey of Potato Research in the United Kingdom 1970. Copies from the Potato Marketing Board, 50 Hans Crescent, Knightsbridge, London S.W.1. 2*s*. 9*d*. post free.

Ploughing Practice in the Forestry Commission. G. G. M. Taylor. H.M.S.O., 1970. 4*s*.

All About Pigs. Entirely New Edition. Over 700 questions answered. Farming Press (Books) Ltd., 1970. 20*s*.

Agriculture and Britain's Trade Policy Dilemma. T. E. Josling. Copies from Trade Policy Research Centre, 6 Buckingham Street, London W.C.2. 1970. 10*s*.

Census of Woodlands 1965-67. A Report on Britain's Forest Resources by the Forestry Commission. H.M.S.O., 1970. 12*s*.

Agricultural Chemicals Approval Scheme

Tenth List of Additions to the 1970 List of Approved Products for Farmers and Growers.

NEW CHEMICALS

BENOMYL

A systemic organic fungicide for control of blossom wilt (apple), Botrytis (blackcurrant, gooseberry, strawberry, french bean and under glass, lettuce, tomato, pot plants), Gloeosporium and eye rot (apple), leaf mould (tomato), leaf spots (blackcurrant, celery), powdery mildews (apple, blackcurrant, gooseberry, strawberry, cucumber, pot plants), scab (apple, pear).

Wettable Powders

Du Pont Benlate Benomyl Fungicide—Du Pont

CHLORTOLURON

A contact and residual herbicide for control of blackgrass, other annual grasses and some annual broadleaved weeds post-emergence in winter barley and winter wheat.

Wettable Powders

Dicurane—Ciba

FORMETANATE

A carbamate acaricide for control of red spider mite on apple.

Soluble Powders

Dicarzol—Boots

TRIDEMORPH

A systemic organic fungicide for control of powdery mildew of spring barley.

Liquid Formulations

Calixin—BASF
Calixin—Cyanamid

NEW APPROVED USES OF APPROVED CHEMICALS

THIOMETON

The liquid formulations are now approved for control of aphids on brassicas, cereals, apple (pre-blossom only) and strawberry (Approval on certain other crops was announced in the third list of additions, May 1970).

NEW PRODUCTS CONTAINING APPROVED CHEMICALS

AZIPROTRYNE with SIMAZINE

A new mixture for control of a wide range of annual weeds pre or post-emergence in pea.

Wettable Powders

Pemate Plus—Ciba

2,4-D

Amine Salt Formulations
Syford—Synchemicals
Ester Formulations
For-ester—Synchemicals

DICHLORPROP with MCPA

Potassium and Sodium Salt Formulations
Hemoxone—Plant Protection

ETHIRIMOL

A formulation for spray application to control powdery mildew of spring barley is now approved (Approval of a seed dressing formulation was announced in the seventh list of additions, October 1970).

Liquid Spray Formulations

Milstem Spray—Plant Protection

FENITROTHION

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